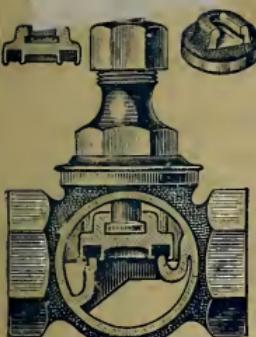


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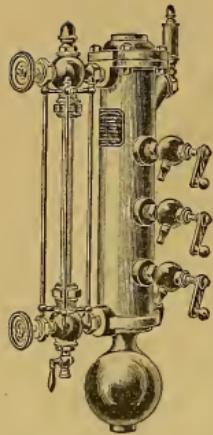
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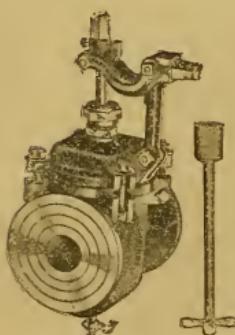
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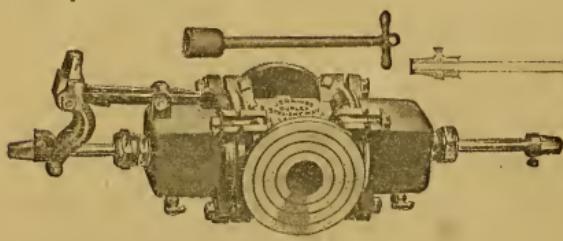
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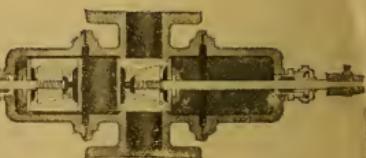
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PREFACE.

In presenting this, the first annual edition of "The Engineer's Reference of Philadelphia," the publishers are disposed to let the work speak for itself.

It is intended that a copy of this book shall be in every engine room in the Metropolitan District of Philadelphia, for the sole convenience of the man in charge, thus enabling him to obtain the name and address of those who handle the goods he may want, without searching all over his building for the different City Directories. It has been our aim in the compilation of this book to make it of value to all interested, and realizing the importance of accuracy, we have endeavored to have every name, address and business heading absolutely correct. In addition to the Supply House Directory will be found the Laws Governing the Inspection of Steam Boilers in the city of Philadelphia, and Rules and Requirements of the National Board of Fire Underwriters, for the Installation of Wiring, and Apparatus for Electric Light, Heat and Power, as recommended by the Underwriters' National Electric Association. This information will be found valuable alike to engineers, electricians and owners of steam and electric plants.

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The Object of this Publication.

To the Engineer and Electrician:

To place in your hand for Reference Purposes a Complete Classified List of those manufacturing and dealing in supplies for your Boiler, Engine or Dynamo Room.

It will also furnish you with the State Laws governing the Inspection of Steam Boilers and the rules and requirements of the National Board of Fire Underwriters for the Installation of wiring and apparatus for Electric Light, Heat and Power as recommended by the Underwriters' National Electric Association.

To the Manufacturer and Dealer:

You will find this Reference book an excellent medium for the introduction of your line of Materials to Engineers, Electricians and the Steam and Electrical trade generally.

The large number of copies that will be distributed in this District makes it the most valuable advertising medium to all anxious to reach those lines of trade.

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ACT OF ASSEMBLY REGULATING THE INSPECTION OF STEAM BOILERS IN AND FOR
THE CITY OF PHILADELPHIA, APPROVED MAY 7, 1864.

1. That the Mayor of the City of Philadelphia may nominate, in the month of June, annually, and by and with the advice of the Select Council of the said City, appoint a person skilful and competent, for the discharge of the duties hereinafter directed to be performed by him, to be the Inspector of Stationary Engines, in and for the City of Philadelphia ; he shall, before entering upon the duties of his office, give bond in the sum of ten thousand dollars, with security, to be approved by the Mayor ; he shall enter upon the performance of his duties on the first Monday of July in every year hereafter, and shall hold until his successor be duly qualified ; any vacancy shall be filled in like manner and the Mayor may at any time suspend the said Inspector from the further performance of the duties, until the Councils of the City of Philadelphia shall otherwise direct.

2. It shall be the duty of the Inspector carefully to examine and inspect all Stationary Steam Engines and Steam Boilers, erected or in use at the time this goes into effect ; and thereafter no Stationary Steam Engines or Steam Boilers shall be erected and put into use and operation in the City of Philadelphia, without being first inspected and certified to be competent and safe, under the hand and seal of the officer created by this act ; and he shall furnish to the owner, proprietor or other person using such Engine or Steam Boiler a certificate, under his hand and the seal of his office, that it has been so inspected and found competent and safe ; he shall from time to time, and as often as he may deem expedient, examine all or any such Engines or Steam Boilers in use or operation, and for such purpose, he, together with his Assistants, may enter upon any premises and require the removal of any part of the building, fixtures or machinery, and he shall note in a book, to be kept for that purpose, the result of every such examination ; and he shall, at least once in every year, make such examination, and give certificate of the result thereof, whenever required.

3. The Councils of the City of Philadelphia shall have power to make all needful rules and regulations for the purpose of carrying the foregoing provisions into effect, and shall provide for the establishment of an office for the said Inspector ; also, for so many and such Assistants and other officers as they may deem necessary ; shall fix

adequate rates of compensation for the said Inspector, and all other officers; shall establish the fees for services under this act, which shall be paid into the Treasury of the City of Philadelphia, and shall provide such other regulations as may be necessary to carry into effect the provisions of this act; and they may provide for the performance of the duties hereinbefore enjoined by the Deputies or other Assistants of the said Inspector, as they may deem necessary.

4. If any person shall, on or after the first Monday of July next, maintain or keep in use or operation, or shall thereafter put in use or operation any Stationary Steam Engine or Steam Boiler, within the said City of Philadelphia, without having first received a certificate that the same has been found to be safe and competent, as is hereinbefore provided for, or shall put or keep in use or operation any such Stationary Steam Engine or Steam Boilers, within the said City, after notice from the said Inspector that the same is not competent or safe, he or she, so offending, shall be deemed guilty of a misdemeanor, and, upon conviction in the said Court of Quarter Sessions for the said County, shall be sentenced to pay a fine not exceeding five thousand dollars, and to undergo imprisonment in the jail of said County, either with or without labor, as the Court may direct, for a term not exceeding two years; and each and every such person shall be liable for all damages that may accrue, directly or indirectly, to any person or persons whatever.

JOHN OVERN,
Chief Inspector.

OFFICE:
ROOMS 317 AND 319,
CITY HALL.

Before You Apply
for a License

STUDY THE **POWER**
CATECHISM.

SEE PAGE 4.

“NATIONAL ELECTRICAL CODE.”

RULES AND REQUIREMENTS

OF THE

National Board of Fire Underwriters

FOR THE

Installation of Wiring and Apparatus for Electric Light, Heat and Power, as recommended by the Underwriters' National Electric Association.

EDITION OF 1897.

The National Electrical Code, as it is here presented, is the result of the united efforts of the various Electrical, Insurance, Architectural and allied interests which have, through the National Conference on Standard Electrical Rules, composed of delegates from the following Associations, unanimously voted to adopt them: American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, Underwriters' National Electric Association.

GENERAL PLAN

GOVERNING THE ARRANGEMENT OF RULES.

CLASS A.—Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, etc. Rules 1 to 11.

CLASS B.—Outside Work, all systems and voltages. Rules 12 and 13.

CLASS C.—Inside Work. Rules 14 to 39. Subdivided as follows:

General Rules, applying to all systems and voltages. Rules 14 to 17.

Constant-Current systems: Rules 18 to 20.

Constant-Potential systems.

All voltages. Rules 21 to 23.

Voltage not over 300. Rules 24 to 31.

Voltage between 300 and 3,000. Rules 32 to 37.

Voltage over 3,000. Rules 38 and 39.

CLASS D.—Specifications for Wires and Fittings. Rules 40 to 55.

CLASS E.—Miscellaneous. Rules 56 to 59.

CLASS F.—Marine Wiring. Rules 60 to 72.

In all electric work conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring special attention must be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, taping of conductors and securing and attaching of fittings, are specially conducive to security and efficiency, and will be strongly insisted on.

In laying out an installation, except for constant-current systems, the work should, if possible, be started from a center of distribution, and the switches and cut-outs, controlling and connected with the several branches, be grouped together in a safe and easily accessible place, where they can be readily got at for attention or repairs. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

The use of wire-ways for rendering concealed wiring permanently accessible is most heartily endorsed and recommended; and this method of accessible concealed construction is advised for general use.

Architects are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light or power wires, and in specifications for electric gas lighting to require a two-wire circuit, whether the building is to be wired for electric lighting or not, so that no part of the gas fixtures or gas piping be allowed to be used for the gas-lighting circuit.

CLASS A.

STATIONS AND DYNAMO ROOMS.

Includes Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, Etc.

1. **Generators—**

a. Must be located in a dry place.

b. Must never be placed in a room where any hazardous process is carried on, nor in places where they would be exposed to inflammable gases or flyings of combustible material.

Generators—Continued.

c. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry. Where frame insulation is impracticable, the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high-potential machine, which, on account of great weight or for other reasons, can not have its frame insulated from the ground, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must always stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected with the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

d. Every constant-potential generator must be protected from excessive current by a safety fuse, or equivalent device, of approved design in each lead wire.

These devices should be placed on the machine or as near it as possible.

Where the needs of the service make these devices impracticable, the Inspection Department having jurisdiction may, in writing, modify the requirements.

e. Must each be provided with a waterproof cover.

f. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes, and normal speed in revolutions per minute.

2. Conductors—

From generators to switchboards, rheostats or other instruments, and thence to outside lines.

a. Must be in plain sight or readily accessible.

b. Must have an *approved* insulating covering as called for by rules in Class "C" for similar work, except that in central stations, on exposed circuits, the wire which is used must have a heavy braided non-combustible outer covering.

Bus bars may be made of bare metal.

c. Must be kept so rigidly in place that they can not come in contact.

d. Must in all other respects be installed under the same precautions as required by rules in Class "C" for wires carrying a current of the same volume and potential.

3. Switchboards—

a. Must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material.

Special attention is called to the fact that switchboards should not be built down to the floor, nor up to the ceiling, but a space of at least ten or twelve inches should be left between the floor and the board, and from eighteen to twenty-four inches between the ceiling and the board in order to prevent fire from communicating from the switchboard to the floor or ceiling, and also to prevent the forming of a partially concealed space very liable to be used for storage of rubbish and oily waste.

b. Must be made of non-combustible material or of hardwood in skeleton form, filled to prevent absorption or moisture.

c. Must be accessible from all sides when the connections are on the back, but may be placed against a brick or stone wall when the wiring is entirely on the face.

d. Must be kept free from moisture.

e. Bus bars must be equipped in accordance with rules for placing conductors.

4. Resistance Boxes and Equalizers—

(*For construction rules, see No. 52*.)

a. Must be placed on a switchboard, or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive, insulating material.

5. Lightning Arresters—

(*For construction rules, see No. 55.*)

a. Must be attached to each side of every overhead circuit connected with the station. It is recommended to all electric light and power companies that arresters be connected at intervals over systems in such numbers and so located as to prevent ordinary discharges entering (over the wires) buildings connected to the lines.

b. Must be located in readily accessible places away from combustible materials, and as near as practicable to the point where the wires enter the building.

Station arresters should generally be placed in plain sight on the switchboard.

In all cases, kinks, coils and sharp bends in the wires between the arresters and the outdoor lines must be avoided as far as possible.

c. Must be connected with a thoroughly good and permanent ground connection by metallic strips or wires having a conductivity not less than that of a No 6 B. & S copper wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection.

Ground wires for lightning arresters must not be attached to gas pipes within the buildings.

It is often desirable to introduce a choke coil in circuit between the arresters and the dynamo. In no case should the ground wire from a lightning arrester be put into iron pipes, as these would tend to impede the discharge.

6. Care and Attendance.

a. A competent man must be kept on duty where generators are operating.

b. Oily waste must be kept in *approved* metal cans and removed daily.

Approved waste cans shall be made of metal, with legs raising can three inches from the floor, and with self-closing covers.

7. Testing of Insulation Resistance—

a. All circuits must be provided with reliable ground detectors. Detectors which indicate continuously and give an instant and permanent indication of a ground are preferable. Ground wires from detectors must not be attached to gas pipes within the building.

Testing of Insulation Resistance—Continued.

- b. Where continuously indicating detectors are not feasible, the circuits should be tested at least once per day, and preferably oftener.
- c. Data obtained from all tests must be reserved for examination by the Inspection Department having jurisdiction.

These rules on testing to be applied at such places as may be designated by the Inspection Department having jurisdiction.

8. Motors—

- a. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and must be kept clean and dry. Where frame insulation is impracticable the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high-potential machine which, on account of great weight or for other reasons, can not have its frame insulated, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected to the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

- b. Must be wired under the same precautions as required by rules in Class "C," for wires carrying a current of the same volume and potential.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than required by the rated capacity of the motor to provide for the inevitable overloading of the motor at times without over-fusing the wires.

- c. The motor and resistance box must be protected by a cut-out and controlled by a switch (see No. 17 a), said switch plainly indicating whether "on" or "off." Where one-quarter horse-power or less is used on low-tension circuits a single-pole switch will be accepted. The switch and rheostat must be located within sight of the motor, except in such cases where special permission to locate them elsewhere is given, in writing, by the Inspection Department having jurisdiction.

- d. Must have their rheostats or starting boxes located so as to conform to the requirements of Rule 4. In connection with motors the use of circuit breakers, automatic starting boxes and automatic under-load switches is recommended, and they *must* be used when required.

- e. Must not be run in series-multiple or multiple-series.

- f. Must be covered with a waterproof cover when not in use, and, if deemed necessary by the Inspection Department having jurisdiction, must be inclosed in an approved case.

From the nature of the question the decision as to what is an approved case must be left to the Inspection Department having jurisdiction to determine in each instance.

- g. Must when combined with ceiling fans, be hung from insulated hooks, or else there must be an insulator interposed between the motor and its support.

- h. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

9. Railway Power Plants—

- a. Must be equipped in each feed wire before they leave the station with an *approved* automatic circuit breaker (see No. 44) or other device, which will immediately cut off the current in case of a ground. This device must be mounted on a fireproof base, and in full view and reach of the attendant.

10. Storage or Primary Batteries—

- a. When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as applied to similar apparatus fed from dynamo generators developing the same difference of potential.

- b. Storage battery rooms must be thoroughly ventilated.

- c. Special attention is directed to the rules for rooms where acid fumes exist. (See No. 24 j and k.)

- d. All secondary batteries must be mounted on non-absorptive, non-combustible insulators, such as glass or thoroughly vitrified and glazed porcelain.

- e. The use of any metal liable to corrosion must be avoided in connections of secondary batteries.

11. Transformers—

(*For construction rules, see No. 54.*)

- a. In central or sub-stations the transformers must be so placed that smoke from the burning out of the coils or the boiling over of the oil (where oil-filled cases are used) could do no harm.

CLASS B.

OUTSIDE WORK.

All Systems and Voltages.

Wires—

- a. Service wires must have an *approved* rubber insulating covering. (See No. 40 a.) Line wires, other than services, must have an *approved* weatherproof, or rubber insulating covering. (See No. 40 a and b.) All tie wires must have an insulation equal to that of the conductors they confine.

- b. Must be so placed that moisture cannot form a cross connection between them, not less than a foot apart, and not in contact with any substance other than their insulating supports. Service blocks must be covered over their entire surface with at least two coats of waterproof paint.

- c. Must be at least seven feet above the highest point of flat roofs, and at least one foot above the ridge of pitched roofs over which they pass or to which they are attached.

- d. Must be protected by dead insulated guard iron or wires from possibility of contact with other conducting wires or substances to which current may lead. Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

- e. Must be provided with petticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved.

Wires—Continued.

f. Must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

g. Must, where they enter buildings, have drip loops outside, and the holes through which the conductors pass must be bushed with non-combustible, non-absorptive insulating tubes slanting upward toward the inside.

h. Telegraph, telephone and similar wires must not be placed on the same cross-arm with electric light or power wires.

i. The metallic sheathes to cables must be permanently and effectively connected to "earth."

TROLLEY WIRES.

j. Must not be smaller than No. 0 B. & S. copper or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

k. Must have a double insulation from the ground. In wooden pole construction, the pole will be considered as one insulation.

l. Must be capable of being disconnected at the power plant, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen. This rule also applies to feeders.

m. Must be safely protected against accidental contact where crossed by other conductors. Guard wires should be insulated from the ground and should be electrically disconnected in sections of not more than 300 feet in length.

GROUND RETURN WIRES.

n. For the diminution of electrolytic corrosion of underground metal work, ground return wires must be so arranged that the difference of potential between the grounded dynamo terminal and any point on the return circuit will not exceed twenty-five volts.

It is suggested that the positive pole of the dynamo be connected to the trolley line, and that whenever pipes or other underground metal work are found to be electrically positive to the rails or surrounding earth, they be connected by conductors arranged so as to prevent as far as possible current flow from the pipes into the ground.

13. Transformers—

(For construction rules, see No. 54.)

a. Must not be placed inside of any building, excepting central stations, unless by special permission of the Inspection Department having jurisdiction.

b. Must not be attached to the outside walls of buildings, unless separated therefrom by substantial supports.

CLASS C.

INSIDE WORK.

All Systems and Voltages.

GENERAL RULES—ALL SYSTEMS AND VOLTAGES.

14. Wires—

(For special rules, see Nos. 18, 24, 32, 38 and 39.)

a. Must not be of smaller size than No. 14 B. & S., except as allowed under Rules 24 *u* and 40 *c*.

b. Tie wires must have an insulation equal to that of the conductors they confine.

c. Must be so spliced or joined as to be both mechanically and electrically secure without solder; they must then be soldered to insure preservation, and the joint covered with an insulation equal to that on the conductors.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

d. Must be separated from contact with walls, floors, timbers or partitions through which they may pass by non-combustible, non-absorptive insulating tubes, such as glass or porcelain.

Bushings must be long enough to bush the entire length of the hole in one continuous piece, or else the hole must first be bushed by a continuous waterproof tube, which may be a conductor, such as iron pipe; the tube then is to have a non-conducting bushing pushed in at each end so as to keep the wire absolutely out of contact with the conducting pipe.

e. Must be kept free from contact with gas, water or other metallic piping, or any other conductors or conducting material which they may cross, by some continuous and firmly fixed non-conductor, creating a separation of at least one inch. Deviations from this rule may sometimes be allowed by special permission.

f. Must be so placed in wet places that an air space will be left between conductors and pipes in crossing, and the former must be run in such a way that they can not come in contact with the pipe accidentally. Wires should be run over, rather than under, pipes upon which moisture is likely to gather or which, by leaking, might cause trouble on a circuit.

15. Underground Conductors—

a. Must be protected, when brought into a building, against moisture and mechanical injury, and all combustible material must be kept removed from the immediate vicinity.

b. Must not be so arranged as to shunt the current through a building around any catch-box.

16. Table of Carrying Capacity of Wires—

Below is a table showing the allowable carrying capacity of wires containing ninety-eight per cent. pure copper, which must be followed in placing interior conductors:

Table A. Rubber Covered Wires. See No. 40a.		Table B. Weatherproof Wires. See No. 40b.	
B. & S. G.	Ampères.	B. & S. G.	Ampères.
18.	3.	18.	5.
16.	6.	16.	8.
14.	12.	14.	16.
12.	17.	12.	23.
10.	24.	10.	32.
8.	32.	8.	46.
6.	46.	6.	65.
5.	54.	5.	77.
4.	65.	4.	92.
3.	76.	3.	110.
2.	90.	2.	131.
1.	107.	1.	156.
0.	127.	0.	185.
00.	150.	00.	220.
000.	177.	000.	262.
0000.	210.	0000.	312.

B. & S. G. Circular Mills.	Ampères.	Ampères.
200,000.	200.	300.
300,000.	270.	400.
400,000.	330.	500.
500,000.	390.	590.
600,000.	450.	680.
700,000.	500.	760.
800,000.	550.	840.
900,000.	600.	920.
1,000,000.	650.	1,000.
1,100,000.	690.	1,080.
1,200,000.	730.	1,150.
1,300,000.	770.	1,220.
1,400,000.	810.	1,290.
1,500,000.	850.	1,360.
1,600,000.	890.	1,430.
1,700,000.	930.	1,490.
1,800,000.	970.	1,550.
1,900,000.	1,010.	1,610.
2,000,000.	1,050.	1,670.

The lower limit is specified for rubber-covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

The carrying capacity of sixteen and eighteen wire is given, but no smaller than fourteen is to be used, except as allowed under Rules 24 *a* and 40 *c*.

17. Switches, Cut-outs, Circuit Breakers, Etc.—

(For construction rules, see Nos. 43, 44 and 45.)

a. Must, whenever called for, unless otherwise provided (for exceptions see No. 8 *c* and No. 22 *c*), be so arranged that the cut-outs will protect, and the opening of the switch or circuit breaker will disconnect all of the wires; that in a two-wire system the two wires, and in a three-wire system the three wires, must be protected by the cut-out and disconnected by the operation of the switch or circuit breaker.

b. Must not be placed in the immediate vicinity of easily ignitable stuff or where exposed to inflammable gases or dust or to flyings of combustible material.

c. Must, when exposed to dampness, either be inclosed in a waterproof box or mounted on porcelain knobs.

CONSTANT-CURRENT SYSTEMS.

Principally Series Arc Lighting.

18. Wires—

(See also Nos. 14, 15 and 16.)

a. Must have an *approved* rubber insulating covering. (See No. 40 *a*.)

b. Must be arranged to enter and leave the building through an *approved* double-contact service switch (see No. 43), mounted in a non-combustible case, kept free from moisture, and easy of access to police or firemen. So-called "snap switches" must not be used on high potential circuits.

c. Must always be in plain sight, and never incased, except when required by the Inspection Department having jurisdiction.

d. Must be supported on glass or porcelain insulators, which separate the wire at least one inch from the surface wired over, and must be kept *rigitly* at least eight inches from each other, except within the structure of lamps, on hanger-boards, in cut-out boxes, or like places, where a less distance is necessary.

e. Must, on side walls, be protected from mechanical injury by a substantial boxing, retaining an air space of one inch around the conductors, closed at the top (the wires passing through bushed holes), and extending not less than seven feet from the floor. When crossing floor timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

19. Arc Lamps—

(For construction rules, see No. 49.)

- a. Must be carefully isolated from inflammable material.
- b. Must be provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes to be used.
- c. Must be provided with a wire netting (having a mesh not exceeding one and one-quarter inches around the globe, and an *approved* spark arrester (see No. 50), when readily inflammable material is in the vicinity of the lamps, to prevent escape of sparks, melted copper or carbon. It is recommended that plain carbons, not copper-plated, be used for lamps in such places.

Arc lamps, when used in places where they are exposed to flyings of easily inflammable material, should have the carbons inclosed completely in a globe in such manner as to avoid the necessity for spark arresters.

For the present, globes and spark arresters will not be required on so-called "inverted arc" lamps, but this type of lamp must not be used where exposed to flyings of easily inflammable materials.

- d. Where hanger-boards (see No. 48) are not used, lamps must be hung from insulating supports other than their conductors.

20. Incandescent Lamps in Series Circuits—

- a. Must have the conductors installed as provided in Rule No. 18, and each lamp must be provided with an automatic cut-out.
- b. Must have each lamp suspended from a hanger board by means of rigid tube.
- c. No electro-magnetic device for switches and no system of multiple-series or series-multiple lighting will be approved.
- d. Under no circumstances can they be attached to gas fixtures.

CONSTANT-POTENTIAL SYSTEMS.

GENERAL RULES—ALL VOLTAGES.

21. Automatic Cut-outs.

(Fuses and Circuit Breakers.)

(See No. 17, and for construction, Nos. 44 and 45.)

- a. Must be placed on all service wires, either overhead or underground, as near as possible to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building.

Where the switch required by rule No. 22 is inside the building, the cut-out required by this section must be placed so as to protect it.

- b. Must be placed at every point where a change is made in the size of wire [unless the cut-out in the larger wire will protect the smaller. (See No. 16.)]

- c. Must be in plain sight, or inclosed in an *approved* box (see No. 46), and readily accessible. They must not be placed in the canopies or shells of fixtures.

- d. Must be so placed that no set of incandescent lamps, whether grouped on one fixture or several fixtures or pendants, requiring a current of more than six amperes shall be dependent upon one cut-out. Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in case of large chandeliers.

- e. Must be provided with fuses, the rated capacity of which does not exceed the allowable carrying capacity of the wire, and when circuit breakers are used, they must not be set more than about thirty per cent. above the allowable carrying capacity of the wire, unless a fusible cut-out is also installed in the circuit (see No. 16).

22. Switches—

(See No. 17, and for construction, No. 43.)

- a. Must be placed on all service wires, either overhead or underground, in a readily accessible place, as near as possible to the point where the wires enter the building, and arranged to cut off the entire current.

- b. Must always be placed in dry, accessible places, and be grouped as far as possible. Knife switches must be so placed that gravity will tend to open rather than close the switch.

- c. Must not be single-pole, except when the circuits which they control supply not more than six 16-candle-power lamps or their equivalent.

- d. Where gangs of flush switches are used, whether with conduit systems or not, the switches must be inclosed in boxes constructed of or lined with fire-resisting material. Where two or more switches are placed under one plate, the box must have a separate compartment for each switch. No push buttons for bells, gas lighting circuits or the like shall be placed in the same wall plate with switches controlling electric light or power wiring.

23. Electric Heaters—

- a. Must, if stationary, be placed in a safe situation, isolated from inflammable materials, and be treated as sources of heat.

- b. Must each have a cut-out and *indicating* switch (see No. 17 a).

- c. Must have the attachments of feed wires to the heaters in plain sight, easily accessible and protected from interference, accidental or otherwise.

- d. The flexible conductors for portable apparatus, such as irons, etc., must have an *approved* insulating covering (see No. 40 c, 3).

- e. Must each be provided with name plate, giving the maker's name and the normal capacity in volts and amperes.

LOW-POTENTIAL SYSTEMS.

300 Volts or Less.

Any circuit attached to any machine, or combination of machines, which develops a difference of potential, between any two wires, of over ten volts and less than 300 volts, shall be considered as a low-potential circuit, and as coming under the class, unless an approved transforming device is used, which cuts the difference of potential down to ten volts or less. The primary circuit not to exceed a potential of 3,000 volts.

GENERAL RULES.

(See also Nos. 14, 15 and 16.)

- a. Must not be laid in plaster, cement or similar finish.
- b. Must never be fastened with staples.
- c. Must not be fished for any great distance, and only in places where the inspector can satisfy himself that the rules have been complied with.

d. Twin wires must never be used, except in conduits, or where flexible conductors are necessary.
 e. Must be protected on side walls from mechanical injury. When crossing floor timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip, not less than one-half inch in thickness, and not less than three inches in width.

Suitable protection on side walls may be secured by a substantial boxing, retaining an air space of one inch around the conductor, closed at the top (the wires passing through bushed holes), and extending not less than five feet from the floor or by an iron-armored or metal-sheathed insulating conduit sufficiently strong to withstand the strain it will be subjected to; or plain metal pipe, lined with insulating tubing, which must extend one-half inch beyond the end of the metal tube.

The pipe must extend not less than five feet above the floor, and may extend through the floor in place of a floorushing.

If iron pipes are used with alternating currents, the two or more wires of a circuit *must* be placed in the same conduit. In this case the insulation of each wire must be reinforced by a tough conduit tubing projecting beyond the ends of the iron pipe at least two inches.

f. When run immediately under roofs, or in proximity to water tanks or pipes, will be considered as exposed to moisture.

SPECIAL RULES.

For open work:

In Dry Places:

- g. Must have an *approved* rubber or weatherproof insulation. (See No. 40 a and b.)
- h. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one-half inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary condition, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches, and run from timber to timber, not breaking around, and may be supported at each timber only.

This rule will be interpreted to forbid the placing of the neutral of a three-wire system in the center of a three-wire cleat, provided the outside wires are separated two and one-half inches.

In damp places, such as Breweries, Packing Houses, Stables, Dye Houses, Paper and Pulp Mills, or buildings specially liable to moisture or acid or other fumes liable to injure the wires or their insulation, except where used for pendants.

- i. Must have an *approved* rubber insulating covering (see No. 40 a).
- j. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring over flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches and run from timber to timber, not breaking around, and may be supported at each timber only.

- k. Must have no joints or splices.

For moulding work:

- l. Must have *approved* rubber insulating covering (see No. 40 a).
- m. Must never be placed in moulding in concealed or damp places.

For conduit work:

- n. Must have an *approved* rubber insulating covering (see No. 40 e).
- o. The use of concentric wire (see No. 40 e) is recommended in preference to twin conductors.
- p. Must not be drawn in until all mechanical work on the building has been, as far as possible, completed.
- q. Must not have wires of different circuits drawn in the same conduit.

It is advised that this be done for direct-current system also, so that they may be changed to alternating systems at any time, induction troubles preventing such a change unless this construction is followed.

For so-called concealed work:

- r. Must have an *approved* rubber insulating covering (see No. 40 a).
- s. Must be rigidly supported on non-combustible, non-absorptive insulators which separate the wire at least one inch from the surface wired over, and must be kept at least ten inches apart, and, when possible, should be run singly on separate timbers or studding.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened.

t. When from the nature of the case it is impossible to place concealed wiring on non-combustible insulating supports of glass or porcelain, the wires, if not exposed to moisture, may be fished on the loop system if incased throughout in approved continuous flexible tubing or conduit. (See page 30.)

For fixture work:

- u. Must have an *approved* rubber insulating covering (see No. 40 d), and shall not be less in size than No. 18 B. & S.

v. Supply conductors, and especially the splices to fixture wires, must be kept clear of the grounded part of gas pipes, and, where shells are used, the latter must be constructed in a manner affording sufficient area to allow this requirement.

w. Must, when fixtures are wired outside, be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture.

25. Interior Conduits—

(See also Nos. 24 n to q, and 41.)

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors to protect them from mechanical injury and, as far as possible, from moisture. Tubes or conduits are to be considered merely as raceways, and are not to be relied upon for insulation between wire and wire, or between the wire and the ground.

a. Must be continuous from one junction box to another or to fixtures, and the conduit tube must properly enter all fittings.

b. Must be first installed as a complete conduit system, without the conductors.

c. Conduits must extend at least one-half inch beyond the finished surface of walls or ceilings, except that, if the end is threaded and a coupling screwed on, the conduit may be left flush with the surface, and the coupling may be removed when work on building is completed.

d. Must, after conductors are introduced, have all outlets plugged with special wood or fibrous plugs, made in parts, and the outlet then sealed with approved compound. Joints must be made air-tight and moisture-proof.

e. Must have the metal of the conduit permanently and effectually grounded.

26. Fixtures—

(See also No. 24 u to w.)

a. Must, when supported from the gas piping of a building, be insulated from the gas-pipe system by means of *approved* insulating joints (see No. 51) placed as close as possible to the ceiling.

It is recommended that the gas outlet pipe be protected above the insulating joint by non-combustible, non-absorptive insulating tube, having a flange at the lower end where it comes in contact with the insulating joint and that, where outlet tubes are used, they be of sufficient length to extend below the insulating joint, and that they be so secured that they will not be pushed back when the canopy is put in place. Where iron ceilings are used, care must be taken to see that the canopy is thoroughly and permanently insulated from the ceiling.

b. Must have all burs, or fins, removed before the conductors are drawn into the fixture.

c. The tendency to condensation within the pipes should be guarded against by sealing the upper end of the fixture.

d. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

e. Must be tested for "contacts" between conductors and fixtures for "short circuits" and for ground connections before it is connected to its supply conductors.

f. Ceiling blocks of fixtures should be made of insulating material; if not, the wires in passing through the plate must be surrounded with non-combustible, non-absorptive insulating material, such as glass or porcelain.

27. Sockets—

(For construction rules, see No. 47.)

a. In rooms where inflammable gases may exist the incandescent lamp and socket must be inclosed in a vapor-tight globe, and supported on a pipe-hanger, wired with approved rubber-covered wire (see No. 40 a) soldered directly to the circuit.

b. In damp or wet places, or over specially inflammable stuff, waterproof sockets must be used.

When waterproof sockets are used, they should be hung by separate stranded rubber-covered wires not smaller than No. 4 B. & S., which should preferably be twisted together when the drop is over three feet. These wires should be soldered direct to the circuit wires, but supported independently of them.

28. Flexible Cord—

a. Must have an *approved* insulation and covering. (See No. 40 c.)

b. Must not be used as a support for clusters.

c. Must not be used except for pendants, wiring of fixtures and portable lamps or motors.

d. Must not be used in show windows.

e. Must be protected by insulating bushings where the cord enters the socket.

f. Must be so suspended that the entire weight of the socket and lamp will be borne by knots under the bushing in the socket, and above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws.

29. Arc Lights on Low-Potential Circuits—

a. Must have a cut-out (see No. 17 a) for each lamp or each series of lamps.

The branch conductors should have a carrying capacity about fifty per cent. in excess of the normal current required by the lamp to provide for heavy current required when lamp is started or when carbons become stuck without over-fusing the wires.

b. Must only be furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat. Incandescent lamps must not be used for resistant devices.

c. Must be supplied with globes and protected by spark arresters and wire netting around globe, as in the case of arc lights on high-potential circuits. (See Nos. 19 and 50.)

30. Economy Coils—

a. Economy and compensator coils for arc lamps must be mounted on non-combustible, non-absorptive insulating supports, such as glass or porcelain, allowing an air space of at least one inch between frame and support, and in general to be treated like sources of heat.

31. Decorative Series Lamps—

a. Incandescent lamps run in series shall not be used for decorative purposes inside of buildings except by special permission in writing from the Inspection Department having jurisdiction.

HIGH-POTENTIAL SYSTEMS.

300 TO 3,000 VOLTS.

Any circuit attached to any machine, or combination of machines, which develops a difference of potential between any two wires, of over 300 volts and less than 3,000 volts, shall be considered as a high-potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 300 volts or less.

32. Wires—

(See also Nos. 14, 15 and 16.)

- a. Must have an *approved* rubber insulating covering. (See No. 40 a.)
- b. Must be always in plain sight and never incased, except where required by the Inspection Department having jurisdiction.
- c. Must be rigidly supported on glass or porcelain insulators, which raise the wire at least one inch from the surface wired over, and must be kept apart at least four inches for voltages up to 750 and at least eight inches for voltages over 750.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least about every four and one-half feet.

If the wires are unusually liable to be disturbed, the distance between supports should be shortened.

In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about six inches for voltages up to 750 and about ten inches for voltages above 750 and run from timber to timber, not breaking around, and may be supported at each timber only.

- d. Must be protected on side walls from mechanical injury by a substantial boxing, retaining an air space of one inch around the conductors, closed at the top (the wires passing through bushed holes) and extending not less than seven feet from the floor. When crossing floor timbers, in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

33. Transformers (When permitted inside buildings, see No. 18)—

(For construction rules, see No. 54.)

- a. Must be located at a point as near as possible to that at which the primary wires enter the building.
- b. Must be placed in an enclosure constructed of or lined with fire-resisting material; the enclosure to be used only for this purpose, and to be kept securely locked and access to the same allowed only to responsible persons.
- c. Must be effectively insulated from the ground and the enclosure in which they are placed must be practically air-tight, except that it shall be thoroughly ventilated to the outdoor air, if possible, through a chimney or flue. There should be at least six inches air space on all sides of the transformer.

34. Car Wiring—

- a. Must be always run out of reach of the passengers, and must have an *approved* rubber insulating covering. (See No. 40 a.)

35. Car Houses—

- a. Must have the trolley wires securely supported on insulating hangers.
- b. Must have the trolley hangers placed at such a distance apart that, in case of a break in the trolley wire, contact can not be made with the floor.
- c. Must have cut-out switch located at a proper place outside the building, so that all trolley circuits in the building can be cut out at one point, and line circuit breakers must be installed, so that when this cut-out switch is open the trolley wire will be dead at all points within 100 feet of the building. The current must be cut out of the building whenever the same is not in use or the road not in operation.
- d. Must have all lamps and stationary motors installed in such a way that one main switch can control the whole of each installation—lighting or power—Independently of main feeder-switch. No portable incandescent lamps or twin wire allowed, except that portable incandescent lamps may be used in the pits, connections to be made by two *approved* rubber-covered flexible wires (see No. 40 a), properly protected against mechanical injury; the circuit to be controlled by a switch placed outside of the pit.
- e. Must have all wiring and apparatus installed in accordance with rules under Class "C" for constant potential systems.
- f. Must not have any system of feeder distribution centering in the building.
- g. Must have the rails bonded at each joint with not less than No. 2 B. & S. annealed copper wire; also a supplementary wire to be run for each track.
- h. Must not have cars left with trolley in electrical connection with the trolley wire.

36. Lighting and Power from Railway Wires—

- a. Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car houses, and their power stations, nor shall the same dynamo be used for both purposes.

37. Series Lamps—

- a. No system of multiple-series or series-multiple for light or power will be approved.
- b. Under no circumstances can lamps be attached to gas fixtures.

EXTRA-HIGH POTENTIAL SYSTEMS.

OVER 3,000 VOLTS.

Any circuit attached to any machine or combination of machines, which develops a difference of potential, between any two wires, of over 3,000 volts, shall be considered as an extra-high potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 3,000 volts or less.

38. Primary Wires—

Must not be brought into or over buildings, except power and sub-stations.

39. Secondary Wires—

- a. Must be installed under Rules for high-potential systems, when their immediate primary wires carry a current at a potential of over 3,000 volts.

The high line insulation required for extra-high potential current tends to make the insulation resistance between primary and secondary coils of transformers a comparatively weak point, and lightning discharges would be apt to take this path to the earth. With the present means of protection against transformer break-downs and the consequent liability of secondary wiring being subject to the strain of the primary current, it is not deemed advisable to permit a primary current with a potential of over 3,000 volts without an intermediate step-down transformer. The presence of wires carrying a current at a potential of over 3,000 volts in the streets of cities and towns is also considered as increasing the fire hazard.

CLASS D.

FITTINGS, MATERIALS AND DETAILS OF CONSTRUCTION.

All Systems and Voltages.

40. Wire Insulation.

a. Rubber Covered—The insulating covering must be solid, at least three-sixty-fourths of an inch in thickness and covered with a substantial braid. It must not readily carry fire, must show an insulating resistance of one megohm per mile after two weeks' submersion in water at seventy degrees Fahrenheit and three days' submersion in lime water, and after three minutes' electrification with 550 volts. (See page 44.)

b. Weatherproof—The insulating covering must not support combustion, must resist abrasion, must be at least one-sixteenth of an inch in thickness, and thoroughly impregnated with a moisture repellent.

c. Flexible Cord—Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than a No. 16 B. & S. wire, and each covered by an *approved* insulation, and protected by a slow-burning, tough-braided outer covering.

1. Insulation for *pendants* under this rule must be moisture and flame proof.

2. Insulation for *CORDS used for all other purposes*, including portable lamps and motors, must be solid, at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

3. The flexible conductors for *portable heating apparatus*, such as irons, etc., must have an insulation that will not be injured by heat, such as asbestos, which must be protected from mechanical injury by an outer, substantial braided covering, and so arranged that mechanical strain will not be borne by the electrical connection.

d. Fixture Wire—Must have a solid insulation, with a slow-burning, tough, outer covering. The whole to be at least one-thirty-second of an inch in thickness, and show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile, after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

e. Conduit Wire—Must comply with the following specifications:

1. For *insulated metal conduits* single wires and twin conductors must comply with section (a) of this rule.

Concentric wire must have a braided covering between the outer conductor and the insulation of the inner conductor, and, in addition, must comply with section (a) of this rule.

2. For *non-insulated metal conduits* single wires and twin conductors must comply with section (a) of this rule, and, in addition, have a second outer fibrous covering, at least one-thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

Concentric conductors must have a braided covering between the outer conductor and the insulation of the inner conductor, and comply with section (a) of this rule, and, in addition, must have a second outer fibrous covering at least one-thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

41. Interior Conduits—

(For wiring rules, see Nos. 24 and 25.)

a. Each length of conduit, whether insulated or uninsulated, must have the maker's name or initials stamped in the metal or attached thereto in a satisfactory manner, so that the inspectors can readily see the same.

Insulated Metal Conduits :

b. The metal covering or pipe must be at least equal in thickness or of equal strength to resist penetration by nails, etc., as the ordinary commercial form of gas pipe of same size.

c. Must not be seriously affected externally by burning out a wire inside the tube when the iron pipe is connected to one side of the circuit.

d. Must have the insulating lining firmly secured to the pipe.

e. The insulating lining must not crack or break when a length of the conduit is uniformly bent at temperature of 212 degrees Fahrenheit to an angle of ninety degrees, with a curve having a radius of fifteen inches, for pipes of one inch and less, and fifteen times the diameter of pipe for larger pipes.

f. The insulating lining must not soften injuriously at a temperature below 212 degrees Fahrenheit and must leave water in which it is boiled practically neutral.

g. The insulating lining must be at least one-thirty-second of an inch in thickness, and the materials of which it is composed must be of such a nature as will not have a deteriorating effect on the insulation of the conductor, and be sufficiently tough and tenacious to withstand the abrasion test of drawing in and out of same long lengths of conductors.

h. The insulating lining must not be mechanically weak after three days' submersion in water, and when removed from the pipe entire, must not absorb more than ten per cent. of its weight of water during 100 hours of submersion.

i. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve of the inner edge of any elbow not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

Uninsulated Metal Conduits:

j. Plain iron or steel pipes of equal thickness, or of equal strength, to resist penetration of nails, etc., as the ordinary commercial form of gas pipe of the same size, may be used as conduits, provided their interior surfaces are smooth and free from burs; pipe to be galvanized, or the interior surfaces coated or enameled to prevent oxidization with some substance which will not soften so as to become sticky and prevent wire from being withdrawn from the pipe.

k. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve of the inner edge of any elbow not to be less than three and one-half inches. Must not have more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

42. Wooden Mouldings—

(For wiring rules, see No. 24.)

a. Must have, both outside and inside, at least two coats of waterproof paint or to be impregnated with a moisture repellent.

b. Must be made of two pieces, a backing and capping so constructed as to thoroughly incase the wire, and provide a one-half-inch tongue between the conductors, and a solid backing, which, under grooves, shall not be less than three-eighths of an inch in thickness, and must afford suitable protection from abrasion.

It is recommended that only hardwood moulding be used.

43. Switches—

(See Nos. 17 and 22.)

a. Must be mounted on non-combustible, non-absorptive, insulating bases, such as slate or porcelain.

b. Must have carrying capacity sufficient to prevent undue heating.

c. Must, when used for service switches, indicate, on inspection, whether the current be "on" or "off."

d. Must be plainly marked where it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.

e. Must, for constant potential systems, operate successfully at fifty per cent. overload in amperes, with twenty-five per cent. excess voltage under the most severe conditions they are liable to meet with in practice.

f. Must, for constant potential systems, have a firm and secure contact; must make and break readily, and not stop when motion has once been imparted by the handle.

g. Must, for constant current systems, close the main circuit and disconnect the branch wires when turned "off;" must be so constructed that they shall be automatic in action, not stopping between points when started, and must prevent an arc between the points under all circumstances. They must indicate, upon inspection, whether the current be "on" or "off."

44. Cut-outs and Circuit Breakers—

(For installation rules, see Nos. 17 and 21.)

a. Must be supported on bases of non-combustible, non-absorptive insulating material.

b. Cut-outs must be provided with covers, when not arranged in approved cabinets, so as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

c. Cut-outs must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits with fuses rated at 50 per cent. above and with a voltage 25 per cent. above the current and voltage for which they are designed.

d. Circuit-breakers must operate successfully under the most severe conditions they are liable to meet with in practice, on short circuits when set at 50 per cent. above the current, and with a voltage 25 per cent. above that for which they are designed.

e. Must be plainly marked where it will always be visible, with the name of the maker, and current and voltage for which the device is designed.

45. Fuses—

(For installation rules, see Nos. 17 and 21.)

a. Must have contact surfaces or tips of harder metal having perfect electrical connection with the fusible part of the strip.

b. Must be stamped with about 80 per cent. of the maximum current they can carry indefinitely, thus allowing about 25 per cent. overload before fuse melts.

With naked open fuses of ordinary shapes and not over 500 amperes capacity, the *maximum current* which will melt them in about five minutes may be safely taken as the melting point, as the fuse practically reaches its maximum temperature in this time. With larger fuses a longer time is necessary.

Inclosed fuses where the fuse is often in contact with substances having good conductivity to heat, and often of considerable volume, require a much longer time to reach a maximum temperature on account of the surrounding material which heats up slowly.

This data is given to facilitate testing.

c. Fuse terminals must be stamped with the maker's name, initials, or some known trade mark.

46. Cut-out Cabinets—

a. Must be so constructed, and cut-outs so arranged, as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

A suitable box can be made of marble, slate or wood, strongly put together, the door to close against a rabbet so as to be perfectly dust tight, and it should be hung on strong hinges and held closed by a strong hook or catch. If the box is wood the inside should be lined with sheets of asbestos board about one-sixteenth of an inch in thickness, neatly put on and firmly secured in place by shellac and tacks. The wires should enter through holes bushed with porcelain bushings; the bushings tightly fitting the holes in the box, and the wires tightly fitting the bushings (using tape to build up the wire, if necessary) so as to keep out the dust.

47. Sockets—

(See No. 27.)

a. No portion of the lamp socket, or lamp base, exposed to contact with outside objects, must be allowed to come into electrical contact with either conductor.

b. Must, when provided with keys, comply with the requirements for switches. (See No. 48.)

48. Hanger-boards—

a. Hanger-boards must be so constructed that all wires and current carrying devices thereon shall be exposed to view and thoroughly insulated by being mounted on a non-combustible, non-absorptive insulating substance. All switches attached to the same must be so constructed that they shall be automatic in their action, cutting off both poles to the lamp, not stopping between points when started and preventing an arc between points under all circumstances.

49. Arc Lamps—

(*For installation rules, see No. 19.*)

a. Must be provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

b. Must be carefully insulated from the circuit in all their exposed parts.

c. Must, for constant current systems, be provided with an *approved* hand switch, also an automatic switch that will shunt the current around the carbons, should they fail to feed properly.

The hand switch to be approved, if placed anywhere except on the lamp itself, must comply with requirements for switches on hanger-boards as laid down in Rule 48.

50. Spark Arresters—

(*See No. 19 c.*)

a. Spark arresters must so close the upper orifice of the globe that it will be impossible for any sparks, thrown off by the carbons, to escape.

51. Insulating Joints—

(*See No. 26 a.*)

a. Must be entirely made of material that will resist the action of illuminating gases, and will not give way or soften under the heat of any ordinary gas flame or leak under a moderate pressure. They shall be so arranged that a deposit of moisture will not destroy the insulating effect, and shall have an insulating resistance of at least 250,000 ohms between the gas-pipe attachments, and be sufficiently strong to resist the strain they will be liable to be subjected to in being installed.

b. Insulating joints having soft rubber in their construction will not be approved.

52. Resistance Boxes and Equalizers—

(*For installation rules, see No. 4.*)

a. Must be equipped with metal, or with other non-combustible frames.

The word "frame" in this section relates to the entire case and surroundings of the rheostat, and not alone to the upholding supports.

53. Reactive Coils and Condensers—

a. Reactive coils must be made of non-combustible material, mounted on non-combustible bases and treated, in general, like sources of heat.

b. Condensers must be treated like apparatus operating with equivalent voltage and currents. They must have non-combustible cases and supports, and must be isolated from all combustible materials and, in general, treated like sources of heat.

54. Transformers—

(*For installation rules, see Nos. 11 and 33.*)

a. Must not be placed in any but metallic or other non-combustible cases.

55. Lightning Arresters—

(*For installation rules, see No. 5.*)

a. Must be mounted on non-combustible bases, and must be so constructed as not to maintain an arc after the discharge has passed and must have no moving parts.

CLASS E.

MISCELLANEOUS.

56. Insulation Resistance—

The wiring in any building must test free from grounds, *i. e.*, the complete installation must have an insulation between conductors and between all conductors and the ground (not including attachments, sockets, receptacles, etc.) of not less than the following:

Up to	5 amperes	.....	4,000,000
"	10 "	.....	2,000,000
"	25 "	.....	800,000
"	50 "	.....	400,000
"	100 "	.....	200,000
"	200 "	.....	100,000
"	400 "	.....	50,000
"	800 "	.....	25,000
"	1,600 "	and over.....	12,500

All cut-outs and safety devices in place in the above.

Where lamp sockets, receptacles and electroliers, etc., are connected, one-half of the above will be required.

57. Protection Against Foreign Currents—

a. Where telephone, telegraph or other wires, connected with outside circuits, are bunched together within any building, or where inside wires are laid in conduits or ducts with electric light or power wires, the covering of such wires must be fire-resisting, or else the wires must be inclosed in an air-tight tube or duct.

b. All aerial conductors and underground conductors, which are directly connected to aerial wires, connecting with telephone, telegraph, district messenger, burglar-alarm, watch-clock, electric-time and other similar instruments, must be provided near the point of entrance to the building with some approved protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest any abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor charged with a relatively high pressure.

Protectors must have a non-combustible insulating base, and the cover to be provided with a lock similar to the lock now placed on telephone apparatus or some equally secure fastening, and to be installed under the following requirements:

1. The protector to be located at the point where the wires enter the building, either immediately inside or outside of the same. If outside, the protector to be enclosed in a metallic, waterproof case.
2. If the projector is placed inside of building, the wires of the circuit from the support outside to the binding posts of the protector to be of such insulation as is approved for service wires of electric light and power (see No. 40 a) and the holes through the outer wall to be protected by bushing the same as required for electric light and power service wires.

3. The wire from the point of entrance to the protector to be run in accordance with rules for high-potential wires, *i.e.*, free of contact with building and supported on non-combustible insulators.

4. The ground wire shall be insulated, not smaller than No. 16 B. & S. gauge copper wire. This ground wire shall be kept at least three inches from all conductors, and shall never be secured by uninsulated, double-pointed tacks, and must be run in as straight a line as possible to the ground connection.

5. The ground wire shall be attached to a water pipe, if possible, otherwise may be attached to a gas pipe. The ground wire shall be carried to, and attached to, the pipe outside of the first joint or coupling inside the foundation walls, and the connection shall be made by soldering, if possible. In the absence of other good ground, the ground shall be made by means of a metallic plate or a bunch of wires buried in a permanently moist earth.

58. Electric Gas Lighting—

Where electric gas lighting is to be used on the same fixture with the electric light:

- a. No part of the gas piping or fixture shall be in electric connection with the gas lighting circuit.
- b. The wires used with the fixtures must have a non-inflammable insulation, or where concealed between the pipe and shell of the fixture, the insulation must be such as required for fixture wiring for the electric light.

c. The whole installation must test free from "grounds."

d. The two installations must test perfectly free from connection with each other.

59. Soldering Fluid—

- a. The following formula for soldering fluid is suggested:

Saturated solution of zinc chloride.....	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

APPROVED MATERIALS.

Wires—

The following is a list of wires constructed to comply with the standard given in Rule 40 a. Result of recent tests on these and on other wires can be seen at inspection offices:

Name of Wire.	Manufacturer.
Americanite	American Electrical Works.
Bishop	Bishop Gutta Percha Co.
Clark	Eastern Electric Cable Co.
Climax	Simplex Electric Co.
Simplex (caoutchouc).....	" " "
Acme	Simplex Electrical Co.
C. C	Canadian General Electric Co.
Crescent	John A. Roebling's Sons Co.
Crown	Washburn & Moen.
Globe	" " "
Crefeld	Crefeld Electrical Works.
Grimshaw (White core).....	N. Y. Insulated Wire Co.
Raven (Black core)	" " " " "
Raven (White core)	" " " " "
Regna (White core)	Safety Insulated Wire and Cable Co.
Safety (Black core)	Ind. Rubber & Gutta Percha Ins. Co.
Habirshaw (White core).....	" " " " "
" (Blue core)	Indiana Rubber & Insulated Wire Co.
" (Red core)	Atlas Covering Works.
Paramite	W. R. Brixey.
Liberty	Okonite Co., Limited.
Kerite	Nat. India Rubber Co.
Okonite	" " " "
Paracore	General Electric Co.
N. I. R	Standard Underground Cable Co.
Double Rubber Core	Phillips Insulated Wire Co.
Double Rubber (Red core)	
Sterling	
Tip Top	
Phillips	

Materials—

The following are given as a list of NON-COMBUSTIBLE, NON-ABSORPTIVE INSULATING materials and are listed here for the benefit of those who might consider hard rubber, fiber, wood and the like as fulfilling the above requirements. Any other substance, which it is claimed should be accepted, must be forwarded for testing before being put on the market:

1. Glass.
2. Marble (filled).
3. Slate without metal veins.
4. Porcelain, thoroughly glazed and vitrified.
5. Pure Sheet Mica.
6. Lava (certain kinds of).
7. Alberene Stone.

Iron-Armored Insulated Conduits—

The iron and steel-armored conduits manufactured by the Interior Conduit and Insulation Company, the Amorite Company, the Clifton Manufacturing Company, and the Consolidated Tube Company have been tested and in general have given good results in practice.

Flexible Tubing—

(See No. 24 t.)

American Circular Loom tubing is approved for use under rule 24, section t.

CLASS F.**MARINE WORK.****60. Generators—**

- a. Must be located in a dry place.
- b. Must have their frames insulated from their bed-plates.
- c. Must each be provided with a waterproof cover.
- d. Must each be provided with a name plate, giving the maker's name, the capacity in voltage and amperes and normal speed in revolutions per minute.

61. Wires—

- a. Must have an *approved* insulating covering.

The insulation for all conductors, except for portables, to be approved, must be at least one-eighth inch in thickness and be covered with a substantial waterproof and flameproof braid. The physical characteristics shall not be affected by any change in temperature up to 200 degrees Fahrenheit. After two weeks' submersion in salt water at 70 degrees Fahrenheit it must show an insulation resistance of one megohm per mile after three minutes' electrification, with 550 volts.

- b. Must have no single wire larger than No. 12 B. & S. Wires to be stranded when greater capacity is required. No single solid wire smaller than No. 14 B. & S., except in fixture wiring, to be used.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire they must be soldered into lugs.

- c. Must be supported in approved molding, except at switchboards and portables.

Special permission may be given for deviation from this rule in dynamo rooms.

- d. Must be bushed with hard rubber tubing one-eighth inch in thickness when passing through beams and non-water-tight bulkheads.

e. Must have, when passing through water-tight bulkheads and through all decks, a metallic stuffing tube lined with hard rubber. In case of deck tubes they shall be boxed near deck to prevent mechanical injury.

f. Splices or taps in conductors must be avoided as far as possible. Where it is necessary to make them they must be so spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered to insure preservation, covered with an insulating compound equal to the insulation of the wire, and further protected by a waterproof tape. The joint must then be coated or painted with a waterproof compound.

62. Portable Conductors—

- a. Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than No. 14 B. & S. wire, and each covered with an approved insulation and covering.

Where not exposed to moisture or severe mechanical injury, each stranded conductor must have a solid insulation at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at 70 degrees Fahrenheit and after three minutes' electrification, with 550 volts, and be protected by a slow-burning, tough-braided outer covering.

Where exposed to moisture and mechanical injury—as for use on decks, holds and fire-rooms—each stranded conductor shall have a solid insulation, to be approved, of at least one-thirty-second of an inch in thickness and protected by a tough braid. The two conductors shall then be stranded together, using a jute filling. The whole shall then be covered with a layer of flax, either woven or braided, at least one-thirty-second of an inch in thickness, and treated with a non-inflammable, waterproof compound. After one week's submersion in water at 70 degrees Fahrenheit, with 550 volts, and a three minutes' electrification, must show an insulation between the two conductors, or between either conductor and the ground, of one megohm per mile.

63. Bell or Other Wires—

- a. Shall never be run in same duct with lighting or power wires.

64. Table of Capacity of Wires—

B. & S. G.	Area Actual C. M.	No. of Strands	Size of Strands	Amperes. B. & S. G.
19	1,288	..	..	..
18	1,624	..	..	3
17	2,048	..	..	..
16	2,583	..	..	6
15	3,257	..	..	..
14	4,107	..	..	12
12	6,530	..	..	17
..	9,016	7	19	21
..	11,368	7	18	25
..	14,336	7	17	30
..	18,081	7	16	35
..	20,799	7	15	40
..	30,856	19	18	50
..	38,912	19	17	60
..	49,077	19	16	70
..	60,088	37	18	85
..	75,776	37	17	100
..	99,064	61	18	120
..	124,928	61	17	145
..	157,503	61	16	170
..	198,677	61	15	200
..	250,527	61	14	235
..	296,387	91	15	270
..	373,737	91	14	320
..	413,639	127	15	340

When greater conducting area than that of 12 B. & S. G. is required, the conductor shall be stranded in a series of 7, 19, 37, 61, 91 or 127 wires, as may be required; the strand consisting of one central wire, the remainder laid around it concentrically, each layer to be twisted in the opposite direction from the preceding.

65. Switchboards—

- a. Must be made of non-combustible, non-absorptive insulating material, such as marble or slate.
- b. Must be kept free from moisture, and must be located so as to be accessible from all sides.
- c. Must have a main switch, main cut-out and ammeter for each generator.
Must also have a volmeter and ground detector.
- d. Must have a cut-out and switch for each side of each circuit leading from board.

66. Resistance Boxes—

- a. Must be made of non-combustible material.
- b. Must be located on switchboard or away from combustible material. When not placed on switch-board they must be mounted on non-inflammable, non-absorptive insulating material.
- c. Must be so constructed as to allow sufficient ventilation for the uses to which they are put.

67. Switches—

- a. Must have non-combustible, non-absorptive insulating bases.
- b. Must operate successfully at 50 per cent. overload in amperes with 25 per cent. excess voltage under the most severe conditions they are liable to meet with in practice, and must be plainly marked where it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.
- c. Must be double-pole when circuits which they control supply more than six 16-candle-power lamps or their equivalent.
- d. When exposed to dampness, they must be enclosed in a water-tight case.

68. Cut-outs—

- a. Must have non-combustible, non-absorptive insulating bases.
- b. Must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuit with fuse rated at 50 per cent. above, and with a voltage 25 per cent. above the current and voltage they are designed for, and must be plainly marked where they will always be visible with the name of the maker and current and voltage for which the device is designed.
- c. Must be placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller).
- d. In places such as upper decks, holds, cargo spaces and fire-rooms a water-tight and fireproof cut-out may be used, connecting directly to mains when such cut-out supplies not more than six 16-candle-power lamps or their equivalent.
- e. When placed anywhere except on switchboards and certain places, as cargo spaces, holds, fire-rooms, etc., where it is impossible to run from center of distribution, they shall be in a cabinet lined with fire-resisting material.
- f. Except for motors, search-lights and diving lamps shall be so placed that no group of lamps, requiring a current of more than six amperes, shall ultimately be dependent upon one cut-out.

A single-pole covered cut-out may be placed in the moulding when same contains conductors supplying current for not more than two 16-candle-power lamps or their equivalent.

69. Fixtures—

- a. Shall be mounted on blocks made from well seasoned lumber treated with two coats of white lead or shellac.
- b. Where exposed to dampness, the lamp must be surrounded by a vapor-proof globe.
- c. Where exposed to mechanical injury, the lamp must be surrounded by a globe protected by a stout wire guard.
- d. Shall be wired with same grade of insulation as portable conductors which are not exposed to moisture or mechanical injury.

70. Sockets—

- a. No portion of the lamp socket or lamp base exposed to contact with outside object shall be allowed to come into electrical contact with either of the conductors.

71. Wooden Mouldings—

- a. Must be made of well seasoned lumber, and be treated inside and out with at least two coats of white lead or shellac.
- b. Must be made of two pieces, a backing and a capping, so constructed as to thoroughly incase the wire and provide a one-half inch tongue between the conductors, and a solid backing which, under grooves, shall not be less than three-eighths inch in thickness.
- c. Where moulding is run over rivets, beams, etc., a backing strip must first be put up and the moulding secured to this.
- d. Capping must be secured by brass screws.

72. Motors—

- a. Must be wired under the same precautions as with a current of same volume and potential for lighting. The motor and resistance box must be protected by a double-pole cut-out and controlled by a double-pole switch, except in cases where one-quarter horse-power or less is used.

The leads or branch circuits should be designed to carry a current at least 50 per cent. greater than that required by the rated capacity of the motor to provide for the inevitable overloading of the motor at time.

- b. Must be thoroughly insulated. Where possible, should be set on base frames made from filled, hard, dry wood and raised above surrounding deck. On hoists and winches they shall be insulated from bed-plates by hard rubber, fiber or similar insulating material.

c. Shall be covered with a waterproof cover when not in use.

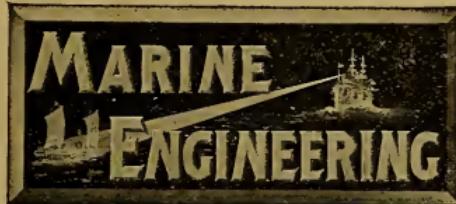
- d. Must each be provided with a name plate giving maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

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3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

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4549 PENNA. MACHINE CO., 31 N. Seventh St. (See page 88.)
PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)

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Howard, Geo. C., Fdy. & Mch. Wks., 1743 Ludlow St.
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1827 SELLERS, WM. & CO., Inc., 1600 Hamilton St. (See page 59.)
6040 WILKINSON MFG. CO., Stephen Girard Bldg. (See page 81.)

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Ajax Metal Co., 46 Richmond St.
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EASTWOOD WIRE MFG. CO., 120 Liberty St., New York. (See inside front cover.)
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Hooks Smelting Co., N. Broad cor. Hamilton St.
McHatton & Wright, 1500 Washington Ave.
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Phosphor Bronze Smelting Co., The Ltd., 2200 Washington Ave.

BELT DRESSING.

Alexander Bros., 410 N. Third St.
CLING-SURFACE MFG. CO., 169-174 Virginia St., Buffalo, N. Y. (See insert opp. page 32.)
1531 DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)
4816 GRATON & KNIGHT MFG. CO., 132 N. Third St. (See page 61.)
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Bowen & Martin, 112 S. Second St.
4747 BOYD, JAS., & BRO., 14 N. Fourth St. (See insert opp. page 57.)
Danforth Belting Co., 221 Chestnut St.
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
Etsweiler, Wm., 230 N. Third St.
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
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Link Belt Engineering Co., The, Hunting Park Ave., Nicetown.
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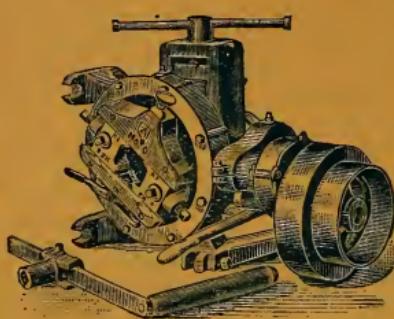
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*** BLAST NOZZLES.**

EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

BLOWERS AND EXHAUST FANS.

B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

Baker, Smith & Co., 520 Commerce St.

Buffalo Forge Co., 593 Bourse Bldg.

EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

Schutte, L., & Co., cor. 12th and Thompson Sts.

*** BLOWER PIPING.**

B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

BLOWERS, POSITIVE PRESSURE.

ROOTS, P. H. & F. M., CO., 109 Liberty St., New York. (See insert opp. page 33.)

*** BLOW-OFF TANKS.**

HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-57.)

BOILER AND PIPE COVERING.

Ainsworth Boiler & Pipe Covering Co., 1513 Filbert St.

ASBESTOS MFG., 426 Market St. (See page 31.)

Bowes & Diehl, 402 Lippincott Bldg.

Brady, Bernard E., 1818 Stephen Girard Bldg.

Collins, Frederic, Jr., 905 Provident Bldg.

GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.

Howley & Co., 683 Mutual Life Bldg.

Janney, Chas. C., 2251 N. Fifth St.

JOHNS, H. W. MFG. CO., 170-172 N. Fourth St.

Lyle, R. Willis, 1420 Callowhill St.

Magnesia Covering Co., 143 N. Broad St.

429 NEW JERSEY ASBESTOS CO., 117 N. Front St., Camden, N. J. (See page 31.)

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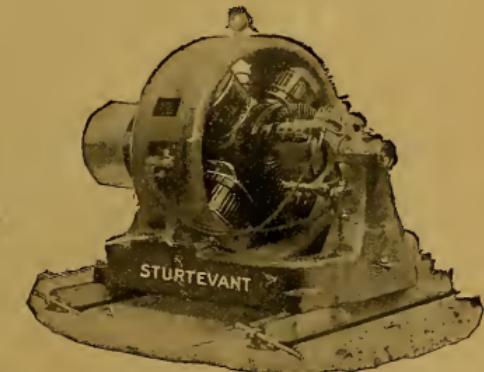
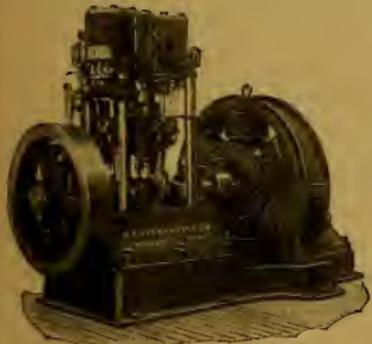
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BOILER CLEANERS (MECHANICAL).

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

BOILER COMPOUND.

Bouggy, Wm. E., 837 N. Third St.
Cherry Chemical Co., 1215 Filbert St.
Collins, Frederic, Jr., 905 Provident Bldg.
DAYTON BOILER COMPOUND CO., Dayton, O. (See page 34).
Francis, Wm., 55 N. Seventh St.
Jenkins, Warner H., Penn Mutual Bldg.
Keystone Chemical M. g. Co., The, Camden, N. J.
Litorfuge Mfg. Co., 1710 Market St.
Lord, Geo. W., 316 Union St.
O'Donnell, H. & Son., 228 Dupont St., Manayunk.
Sorden, John H., 2724 Bridge St., Bridesburg.
WARLEY, THOS. C., & CO., 11 S. Ninth St.

BOILER FEEDERS.

2007 DALLETT, W. P. (Deming and Buffalo Pumps) 49 N. Seventh St.
1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.
4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co's Pumps.) (See page 73.)
216 SCIPLE PUMP & MACHINE CO., 107-109 N. Third St.
4081 SNOW STEAM PUMP WORKS (Thos. C. McBride, Mgr.), 946 Drexel Bldg. (See page 73.)

* BOILER FURNACES.

1111 HAWLEY-DOWN DRAFT FURNACE CO. of Penn. 720 Girard Bldg.

BOILER MAKERS AND DEALERS.

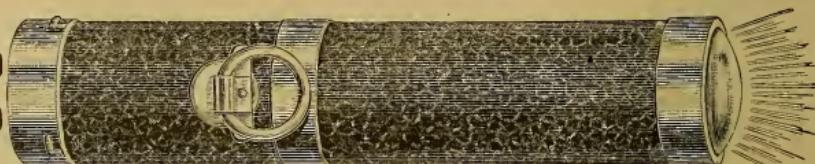
ALMY WATER TUBE BOILER CO., 178-184 Allens Ave., Providence, R. I. (See page 86.)
American Boiler Co., 28 N. Fifth St.
Ames Iron Works, 511 Fidelity Bldg.
5409 ATLAS ENGINE WORKS (Lovegrove & Co., Agents), 143 N. Third St. (See page 45.)
Babcock & Wilcox Co., 642-644 Drexel Bldg.
Baizley, John, 510 S. Delaware Ave.
Bowman, H. L., & C., 31 S. Fourth St.
Burchfield, T. T., 55 N. Seventh St.
Carroll, strick, 1835 Mt. Vernon St.
4549 CHANDLER & TAYLOR CO. (Penna. Machine Co., Agts.) 31 N. Seventh St. (See p. 88.)
Clonbrook Steam Boiler Works, 327 Bourse Bldg.
Coatesville Boiler Works, Inc., 701-702 Fidelity Bldg.
5235A CONARD, T. P., 119 S. Fourth St. (See page 67.)
Connery Boiler Co., 1605 N. Front St.
Cramp, Wm., & Sons, Ship & Engine Bldg. Co., Beach and Palmer Sts.
Erie City Iron Works, 1420 Chestnut St.
Ervin, Chas. W., & Co., 420 Ireland St.
Farquhar, A. B. Co., 470 Bourse Bldg.
5396D FRICK, HORACE E., 421 Chestnut St. (See page 55.)
Gill, John L., Jr., 608 Drexel Bldg.
Fischer Foundry & Machine Co., 30 N. Seventh St.
Gilligan, Wm., & Co., 1108 Beach St.
Goldner, Henry & Son, Tasker St. Wharf, Delaware River.
Guynan, R. B. & Co., 1825 Callowhill St

DAYTON BOILER COMPOUND

Is a powder, clean, cheap and efficient. We are willing to send sufficient quantity for a test, and make no charge for same unless results are satisfactory. Testimonials furnished.

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Cut is one-half size.

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A pocket Electric Lamp for dark corners in Boiler or Engine Room—a *Safe* Lamp for Gas Plants and Mines. In order to introduce our Compound, with the first barrel sold to new customers before February 1st, 1899, we will send **free** one of these Lamps.

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Contractors **Steam Boiler Setting and Engine Foundations**
Furnaces Built and Repaired. Fire Boxes Re-lined. Castings Furnished. a specialty.
We Set Boilers with Special Reference to the Economy of Fuel.

S. E. Corner Fourth and Chestnut Streets, Room A, Brown Building, **PHILADELPHIA**

BOILER MAKERS AND DEALERS—Continued.

6870 **HARRISON SAFETY BOILER WORKS,** 17th St., bel. Allegheny Av. (See pages 50-75.)

4864D **HEINE SAFETY BOILER CO.,** 658 Bourse Bldg. (See page 87.)
Hibbs, Edward A., cor. Bread and Quarry Sts.
Holmes, John E. & Co., 612 Arch St.
Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.
Hunt-r & Faunce, 2054 E. Lehigh Ave.
Innes Bros., 461 E. Girard Ave.
Keeler, E., Co., 614 Betz Bldg.
Kensington Engine Works, Ltd., 704 Arch St.
Keystone Engi. e & Machine Works, cor. Fifth and Buttonwood Sts.
Lebanon Boiler Foundry & Machine Co., 206 N. Fourth St.
Levan, W. Barnet, 2324 N. Broad St.
Levy, Edmund L., 406 Sansom St.
Lidgerwood Mfg. Co., 15 N. Seventh St.

5409 **LOVEGROVE & CO., "ATLAS,"** 143 N. Third St. (See page 45.)
Lundley, Joseph, 127 N. Third St.
McAdams, John, 723 Richmond St.
McNeil Boiler Works, 1001 Chestnut St.
Morris, L. P., Co., cor. Beach and Ball Sts.
Myers Wm., 1415 Wood St.
National Water Tube Boiler Co., 306 Girard Bldg.
Naylor, Jacob, Front St. cor. Girard Ave.
New York Safety Steam Power Co., 15 N. Seventh St.
Nuttinger, August, Sr., 826-830 N. Fourth St.

4549 **PENNA. MACHINE CO.,** 31 N. Seventh St. (See page 88.)
Perseverance Mfg. Co., Inc., cor. Locust and 30th Sts

1781 **PHILA. ENGINEERING WORKS, Ltd.,** cor. Meadow and Mifflin Sts.
PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)
Reilly & Payton, 1162 N. Third St.
Rich, J. & G., 120 N. Sixth St.
Schrader, John J., 13 Poplar St.
Sciple, H. M., & Co., 301 Arch St.
Scott, Benj. T., 206 N. Fourth St.
Seyfert's, L. F., Sons, 437 N. Third St.

1527 **SMITH, H. B., CO., THE, 510 Arch St.** (See page 77.)
STIRLING CO., THE, 205 Betz Bldg. (See page 87.)
Tbayer & Co., Inc., 542 Drexel Bldg.
Thompson Bros., 112 Bread St.
Toomey, Frank, 131 N. Third St.
Wanner, Conrad, 1451 N. 10th St.
Warden Mfg. Co., 19th St. cor. Allegheny Ave.
Wilfong Bros., 222 N. 23d St.
Yora Mfg. Co., 476 Bou se Bldg.
Ziegler, Martin, 118 Van Horn St.

BOILERS (HORIZONTAL WATER TUBE).

See also Water and Tube Boilers.

Babcock & Wilcox Co., 642 Drexel Bldg.
Erie City Iron Works, 1420 Chestnut St.
Gill, John L., Jr., Drexel Bldg.

6870 **HARRISON SAFETY BOILER WORKS, N.** 17th St., bel. Allegheny Ave. (See pages 50-75.)

4864D **HEINE SAFETY BOILER CO.,** 658 Bourse Bldg. (See page 87.)
National Water Tube Boiler Co., 202 Stephen Girard Bldg.
New York Safety Steam Power Co., 15 N. Seventh St.

1781 **PHILA. ENGINEERING WORKS (Ltd.),** cor. Meadow and Mifflin Sts.
PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)
STIRLING CO., THE, 205 Betz Bldg. (See page 87.)
Thayer & Co., Inc., 542 Drexel Bldg.

BOILERS (VERTICAL WATER TUBE).

See also Water Tube Boilers.

ALMY WATER TUBE BOILER CO., 178-184 Allens Ave., Providence, R. I. (See page 86.)
Clonbrook Steam Boiler Co., 327 Bourse Bldg.
McNeil Boiler Works, The, 509 Mutual Life Bldg.
Thayer & Co., Inc., 542 Drexel Bldg.

BOILER SETTING.

Delmar, Jas. L., 2425 E. Allegheny Ave.
Gear, Washington J., Jr., 12 N. Seventh St.
Glenn, J. Temple, 1031 Sansom St.
Haldeman, J. C., 1809 N. Marshall St.
Hyzer, William C., 1230 Marlborough St.
McElwee, J., 1629 South St.
TAYLOR, W. H. H., & SON, Room A, Brown Bldg. (See page 35.)
Williams, Wm. T., 6 S. Third St.

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Philadelphia Book Co.,

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Allison Mfg. Co., The, cor. Walnut and 32d Sts.
American Tube Works, 543 Bourse Bldg.

Belfield, H., & Co., 435 N. Broad St.

1760 CRANE CO., 220-222 S. Fifth St. (See page 79.)
Morris, Tasker & Co., Inc., 224 S. Third St.
Randolph & Clowes, 421 Chestnut St.
Swoyer, A. P., Co., 17 N. Seventh St.

* BOLT CUTTING AND HEADING MACHINERY.

1718 CREGAR, J. W., Machinery Department, Bourse Bldg. (See insert opp. page 11.)
* BOLT DIES.

ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)

BOOKS (MECHANICAL).

AUDEL, THEO., & CO., 63 Fifth Ave., New York.
Baird, Henry Carey, & Co., 810 Walnut St.

PHILADELPHIA BOOK CO., 15 S. Ninth St. (See page 36.)
POWER PUB. CO., World Bldg., New York. (See page 4.)

* BORING MILLS (OF ALL KINDS).

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)
BRASS FOUNDERS AND FINISHERS.

Ajax Metal Co., Inc., 46 Richmond St.

American Tube Works, 543 Bourse Bldg.

Baeurle & Langer, 427 N. Second St.

Belfield, H., & Co., 435 N. Broad St.

Best, Fox & Co., 1210 Betz Bldg.

Binder, G., & Co., 443 and 445 N. 10th St.

Bowman, Job K., 928 Cherry St.

Bureau Bros., cor. 21st St. and Allegheny Ave.

Carver & Howell, 1922 Germantown Ave.

Chesterman, F. E., & Co., 243 Arch St.

Cochucksink Brass Foundry, cor. Fifth and Berks Sts.

Columbia Iron and Brass Foundry, Water St., bel. Moore St.

Comfort, Thomas, & Son, Main St., bel. Umbria St., Manayunk.

Conroy, Joseph A., 1828 S. Water St.

Conroy, P. J., Island road, nr 75th St.

Cooper, Wm. S., 442 N. 13th St.

Cory, C., & Son, 221 Dock St.

Cramp, Wm., & Son's Ship & Engine Building Co., Beach and Ball Sts.

Crown Smelting Co., 514 Walnut St.

Diamond State Iron Co. of Wilmington, Del., 425 Bourse Bldg.

Dunn, N. C., 621 Commerce St.

EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)

Evans, S. W., & Son, 4623 Paul St., Frankford.

6963 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

Fodell, Wm., 2227 Wood St.

Ford Bros. & Co., 243-245 S. Front St.

Frost, Silas (Est.), 55 N. Seventh St.

Fullerton, Frank S., 493 E Girard Ave.

Furlow, Thos., & Sons, 3020 Culvert St.

Gaumer, John L., Co., cor. 11th and Race Sts.

Goldberg Bros., 64 N. Fourth St.

Halstead & Spencer, 1129 Cherry St.

Herman Lewis, 1217 Adams St., Frankford.

Hill, B. B., Mfg. Co., 1020 Mascher St.

Hudermeier, Jos., & Son, 917 Vine St.

Homer Brass Works, 231 Race St.

Homer & Poole, 231 Race St.

Hooks Smelting Co., N. Broad St., cor. Hamilton St.

Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.

Imperial Brass Foundry (Ltd.), 119 Florist St.

Jolley, J. H., & Co., 42 N. Fifth St.

Kirn, M. L., & Bro., 2112 N. Leithgow St.

Krips, Chas., 716 Cherry St.

Lapp, Davis C., 718 Cherry St.

Ledig Co., 248 N. Eighth St.

Lonergan, J. E., & Co., 211 Race St.

Luckhardt, Godfrey, 439 Berks St.

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

McHatton & Wright, 1500 Washington Ave.

Melzer, S. M., 205 Quarry St.

Mills, Thos., & Bro., 1301 N. Eighth St.

Mousley, Chas., 1241 Howard St.

Myers, Alonzo, 4429 Paul St., Frankford.

NEWBURGH ICE MACHINE & ENGINE CO., 1326 Chestnut St.

Newell-Booth Co. (Ltd.), cor. Buttonwood and N. Broad Sts.

North American Smelting Co., 1512 Spring Garden St.

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BRASS FOUNDRERS AND FINISHERS—Continued.

North Bros. Mfg. Co., cor. American St. and Lehigh Ave.
Ott, Geo. F., 207 Buttonwood St.
Perkes, Chas., 637 629 Arch St.
Philadelphia Hardware & Malleable Iron Works, Ninth St., cor. Jefferson St.
Philadelphia Smelting Works, 457 N. 12th St.
Phosphor Bronze Smelting Co. (Ltd.), The, 2209 Washington Ave.
Randolph & Clowes, 421 Chestnut St.
Rohrman, Theo. B., cor. Chestnut and 30th Sts.
Schaefer, Emil, 1320 N. Fifth St.
Schoenwald, Robt., 627 Filbert St. and 1023 Ridge Ave.
Shannon Mfg. Co., cor. 11th and Catherine Sts.
Smith, Chas. W., 1501 Alter St.
Smith, Warren & Bro., 328 Noble St.
Standard Brass Foundry, cor. Hamilton and 13th Sts.
Sweeney, Miller & Co., 328 Nob's St.
Swoyer, A. P., Co., 17 N. Seventh St.
Talmage & Weidley, 228 N. 15th St.
University Mfg. Co., 45 N. Second St.
Waterbury Mfg. Co., 1217 Filbert St.
Wright Mfg. Co., Inc., 141 Master St.

BRASS VALVES.

1514 DILKS, FRANK W., & CO. "LUDLOW," 518 Arch St.
LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

BUILDING AND ROOFING PAPERS.

3148 ASBESTOS MFG. CO., 426 Market St. (See page 31.)

BUSHINGS AND BEARINGS.

EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)

*CENTRIFUGAL PUMPS.

216 SCIPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St.

*CHECK VALVES.

See also Valves.

1514 DILKS, FRANK W., & CO. "LUDLOW," 518 Arch St.
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

CHUCKS.

SKINNER CHUCK CO., THE, New Britain, Conn. (See page 37.)

CLAMPS (ADJUSTABLE).

ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)
McCREA, JAMES, & CO. (Barrett & Plowman, Agents), 1312 Filbert St.

CLUTCHES (FRICTION).

6805 CRESSON, GEO. V., & CO., cor. Allegheny Ave. and 18th St.
Howard, Geo. C., Foundry and Machine Works, 1748 Ludlow St.
Link Belt Engineering Co. (The), Hunting Park Av., Nicetown.
Moore & White Co., cor. Lehigh Ave. and 15th St.
Smith, Jas., & Co., Inc., 411 Race St.

COAL (STEAM).

Berwind-White Coal Mining Co., 305 Betz Bldg.
Black Diamond Coal Co., 1050 N. Ninth St.
Bradley, Walter T., Co., 2306 Ridge Ave.
Bruner, H. F., & Co., Market St., cor. N. 32d St.
Bryant, Wm., 910 Rothschild Bldg.
Caster, Curran & Bullitt, 328 Chestnut St.
Clearfield Bituminous Coal Corporation, 607 Provident Bldg.
Coaldale Mining Co., 717 Terminal Bldg.
Dodson, Weston & Co., 210 Harrison Bldg.
Downing Bros., cor. Walnut and S. 30th Sts.
3005 EDMONDS, G. W., & CO. (Successors to Warner, Shuster & Co., Ltd.), 1920 N. Ninth St. (See page 38.)
Heilner, Percy & Son, 314 Walnut St.
Henderson, Robt., 435 N. Fifth St.
Jennings, Michael, & Sons, 425 Washington Ave.
Kirk, W. C., & Co., 103 S. 30th St.
McCailey Bros., 2737 E. Norris St.
Markham & Hacuser, E. Lehigh Ave., cor. Jasper St.
Newton, Geo. B., & Co., 2929 N. Broad St.
Norton, Chas. D. & Co., 328 Walnut St.
Van Dusen Bros. & Co., 1001 Stephen Girard Bldg.
Weaver, J. H., & Co., 718 Stephen Girard Bldg.

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Walton, Pearson M., 1025 Germantown Ave.

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Darby, Edward, & Sons, 233 Arch St.

Merritt & Co., 1024 Ridge Ave.

COILS, PIPE.

HARRISBURG PIPE BENDING CO., Ltd., 752 Herr St., Harrisburg, Pa.
(See page 51.)

COMPRESSED AIR MOTORS.

UNION BOILER TUBE CLEANER CO., Pittsburg, Pa. (See inserts opp. pages 82-83.)

CONDENSERS FOR ENGINES AND PUMPS.

DALLETT, W. P. (Deming and Buffalo Pumps) 49 N. Seventh St.

DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.

EYNON-EVANS MFG. CO., THE, 15th and Clearfield Sts. (See page 58.)

ROBERTSON, JAS. L., & SONS, Betz Bldg. (See page 79.)

Schutte, L., & Co., cor. 12th and Thompson Sts.

SNOW STEAM PUMP WORKS (T. C. McBride, Mgr.), 946 Drexel Bldg. (See page 73.)

STILWELL-BIERCE & SMITH VAILE CO., THE, 612 Arch St.

COPPER AND BRASS TUBING.

American Tube Works, 543 Bourse Bldg.

Merchant & Co., Inc., 517 Arch St.

Randolph & Clowes, 421 Chestnut St.

COPPERSMITHS.

Baeurle & Langer, 427 N. Second St.

Beer, Paul, 831 N. Fourth St.

Endris, Geo., 700 N. Third St.

Ford Bros. & Co., 243 S. Front St.

Kopperman, Joseph, 404 S. Water St.

Lander, Jacob, 723 S. Sixth St.

Megee, Geo., 307 Branch St.

Mills, Thos., & Bro., 1301 N. Eighth St.

Oat, Joseph, & Sons, 232 Quaery St.

Ott, Geo. F., 207 Buttonwood St.

REILLY, JAS., REPAIR & SUPPLY CO., Washington Ave. Wharf.

Schaefer, Emil, 1322 N. Fifth St.

COTTON WASTE.

Agnew, Harry, 2306 N. Third St.

Ashton, Jam s & Son, 2619 Collins St.

Bergtresser, Samuel, 50 N. 23d St.

Blakeley, John & Son, 1085 Germantown Ave.

Brady, William, Gaul St. cor. Harold St.

Burr Bros., 115 S. Water St. and 116 S. Wharves.

Connell, John J., 32 N. Water St.

Corr & Bro., 1956 N. Second St.

Crompton, Thomas, 247 N. Front St.

Crosland, Enos, 69th and Haverford Sts.

Crowley, B., 2950 N. Secoud St.

Devlin, Charles, 1730 N. 11th St.

Devlin, John, 914 York St.

Fish, James, 1910 E. Letterly St.

French, Hugh, & Son, Third St. cor. Cumberland St.

GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)

Greenwood Law, 121 N. Front St.

Hagy, J. Milton, 109 N. 22d St.

Haigh, Joseph, 1741 N. Front St.

Henry, Thomas, & Sons, 116 Arch St.

Hoffman, Corkran & Co., 415 Market St.

Hongler & Bre dy, 105 N. Water St.

Hooper, Seving & Co., 428 Market St.

Kay, John J., 132 E. Allen St.

Kelly, Francis, 1734 N. Hancock St.

Kempf Bros., 2616 Martha St.

Laverty, John, 2152 E. Letterly St.

McCarthy, Walter S., 17 N. Front St.

McG ath, Charles, 127 N. Front St.

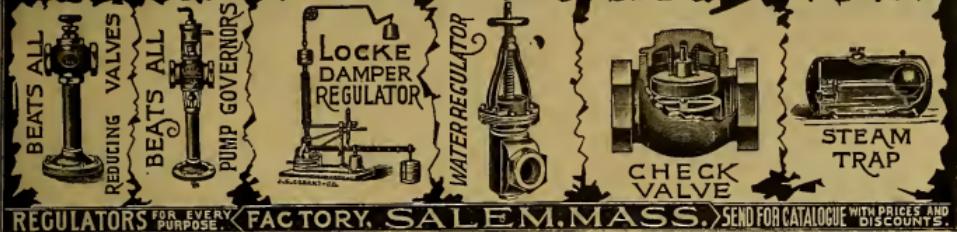
McKenna, Terrence, 2005 N. Hancock St.

McMaster, Thos., 201 Dupont St., Man'yunk.

Maurer, John B., 2552 N. Third St.

Merritt, James R., 38 N. Front St.

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O'Neill Bros., Howard St. cor. Columbia Ave.
 O'Neill, Charles, 57 N. Front St.
 Pink, Abraham, 236 Chestnut St.
 Parsons, William, 4039 Orchard St., Frankford.
 Porter, Henry E., 239 N. Front St.
 Quicksall, Harvey Q. (Cleaner), 4268 Paul St., Frankford.
 Robinson, P. J., 2034-36 and 2007 Arizona St.
 Schofield, James, 4152 Orchard St., Frankford.
 Southern Waste Works, Ltd., 16th St. cor. Carpenter St.
 Sykes, David, Danphion St. cor. Amber St.
 Taggart, John P., 1508 N. American St.
 Wallworth & Sons, 231 Chestnut St.
 Widdall, Edmund & Sons, 221 N. Front St.
 Wilson, Thomas, 105 N. Front St.

CRANES AND STEAM HAMMERS.

1827 Howard, Geo. C., Foundry & Machine Works, 1743 Ludlow St.
 SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)
 Whiting Foundry Equipment Co., Fidelity Bldg.

CUTTERS (PIPE).

ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)
 CURTIS & CURTIS, 200 Garden St., Bridgeport, Conn. (See page 40.)

* CYLINDER (OILS).

See also Oils (Lubricating).

5094 BORNE-SCRYMSEY CO., 223 N. Front St.
 2912 LEONARD & ELLIS, 433 N. Third St.
 5754 N. Y. LUBRICATING OIL CO., 319 Walnut St.
 724 VACUUM OIL CO., 305 Walnut St.
 5836D WILSON CLARK CO., 107 S. Water St.

* CYLINDERS (CARBONIC ACID GAS).

HARRISBURG PIPE BENDING CO., Ltd., 752 Herr St., Harrisburg, Pa.
 (See page 51.)

CYLINDERS REBORED IN POSITION.

Keystone Engine & Machine Works, cor. Fifth and Buttonwood Sts.
 Ruwell, Wm. F., & Co., Washington Ave. and Chadwick St.
 Underwood, H. B., & Co., 1025 Hamilton St.

DAMPER REGULATORS.

Brogan & Co., "Kieley's," 810 Race St.
 Chappell, Geo. H., r. 4365 Main St., Manayunk.
 LOCKE REGULATOR CO., Salem, Mass. (See page 39.)
 ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

Advertising Pays Well

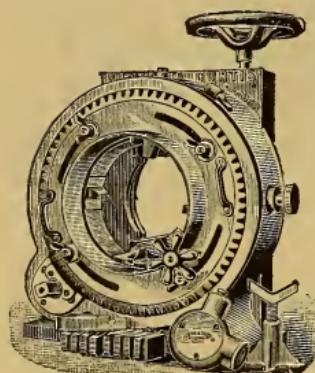
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Two-Inch Pipe Threaded with only one
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One Man can Thread 10-Inch Pipe
with Ease.

OUR HAND MACHINES are the only portable machines with which ONE man alone can cut off and thread 10-inch pipe.

OUR POWER MACHINES occupy less floor space, require less power, are more simple of construction and far cheaper than any other Power Pipe Threading Machine of the range in the market.

DIES AND CUTTERS.

ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)
Chesterman, F. E., & Co., 243 Arch St.

CURTIS & CURTIS, 200 Garden St., Bridgeport, Conn. (See page 40.)
Howard, Geo. C., Foundry & Machine Works, 1743 Ludlow St.

Nacke's Sons, 728 Sansom St.

Snediker & Carr, 133 N. Seventh St.

Standard Die Works, Cherry St. cor. Seventh St.

Stortz, John, & Son, 210 Vine St.

Wright & McDermott, 238 N. Second St.

DIE (SELF-OPENING AND COLLAPSIBLE TAPS).

1718 **CREGAR, J. W.**, Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

DRILLS (RADIAL, VERTICAL, HORIZONTAL AND SENSITIVE).

1718 **CREGAR, J. W.**, Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

*DUST ARRESTERS.

LEE, THOMAS, 209-213 Race St., Cincinnati, O. (See page 49.)

DYNAMOS AND MOTORS.

Blanton Patents Syndicate (Ltd.), 554 Bourse Bldg.

5264 **B. F. STURTEVANT CO.**, 335 N. Third St. (See page 33.)

Bullock Electric Co., 658 Bourse Bldg.

C. & C. Electric Co., 633 Arch St.

Cheyne, W. Irwin, & Co., 1217 Filbert.

Crocker-Wheeler Electric Co., 307 Rothschild Bldg.

4390 **D'OLIER ENGINEERING CO.**, "KEYSTONE," 129 S. 11th St.

Eddy Electric Mfg. Co., 506 Commerce St.

Electro-Dynamic Co., 224 Chestnut St.

Fort Wayne Electric Corp., 101 Bourse Bldg.

Franklin, Ben., Electrical Co., 44 N. Seventh St.

General Electric Co., 509 Arch St.

Holmes Electric Protective Co., 812 Chestnut St.

Hunterdon Electric Co., 1112 Girard Bldg.

Interstate Electric Co., 119 S. Fourth St.

Jandus Electric Co., 422 Bourse Bldg.

4390 **KEYSTONE ELECTRIC CO.**, 129 S. 11th St.

Keystone Electrical Exchange, 128 S. Clifton St.

Kitsee Electric Co., 306 Stock Exchange Place.

Lotos Mfg. Co., 67 N. Second St.

DYNAMOS AND MOTORS—Continued.

1526 **MCINTIRE, WALTER C., & CO., 506 Commerce St.**
Moxham, Edgar C., & Co., 658 Bourse Bldg.
Penn. Heat, Light & Power Co., 1924 Market St.
Powelton Electric Co., 108 S. 40th St.
Quaker City Electric Co., 237 Dock St.
Reed & Morrill, 2910 N. 16th St.
Ridgway Dynamo & Engine Co., 807 Girard Bldg.
Sawyer-Mann Electric Co., 302 Girard Bldg.
Shuttleworth Electric Co., cor. Duncan and Bermuda Sts., Frankford.
Storey Motor & Tool Co., 226 Ionic St.
Strang, R. C., 723 Walnut St.
Walker Co., 748 Drexel Bldg.
Walker & Kepler, 531 Chestnut St.
Ward-Leonard Electric Co., 910 Drexel Bldg.
12116 **WESTINGHOUSE ELECTRIC & MFG. CO., Land Title Bldg.**
West End Electric Co., 1208 N. 31st St.

ECONOMIZERS (FUEL).

FUEL ECONOMIZER CO., THE, "GREENS," Matteawan, N. Y.
Kensington Engine Works (Ltd.), 704 Arch St.

EJECTORS.

6963 **EYNON-EVANS MFG. CO., THE, 15th and Clearfield Sts.** (See page 58.)
3176 **FAIRBANKS CO., THE, 701 Arch St.** (See front cover.)
826 **JENKINS BROS., 117 N. Fourth St.** (See inside front cover.)
PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)
1827 Rue Mfg. Co., 215 Race St.
SELLERS, WM., & CO., INC., 1600 Hamilton St. (See page 59.)
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

ELECTRICAL BELLS.

See also Electrical Supplies.

Bassett, N., & Son, 625 Filbert St.
Brnk & Pickering, 26 N. Seventh St.
Central Electric Co., 13 N. 13th St.
Novelty Electric Co., 54 N. Fourth St.
Shaw, J. Elliott, & Co., 632 Arch St.
Sparrow, Henry A., 1229 Che-tntu St.
Wirt, Chas. S., 1028 Filbert St.

*ELECTRICAL CONTRACTORS AND ENGINEERS.

See also Engineers and Contractors (Electrical).

1526 **MCINTIRE, WALTER C., & CO., 506 Commerce St.**

* ELECTRICAL ENGINE STOPS.

"CORLISS" SPRINGFIELD ENGINE STOP CO., 275 Main, Springfield, Mass.

ELECTRICAL FANS.

5264 **B. F. STURTEVANT CO., 135 N. Third St.** (See page 33.)
C. & C. Electric Co., 633 Arch St.
Etherington Co., 47 S. 17th St.
1526 **MCINTIRE, WALTER C., & CO., 506 Commerce St.**
Stewart, Frank H., & Co., 35 N. Seventh St.
Vallee Bros. & Co., 625 Arch St.

* ELECTRICAL FAN MOTORS.

5264 **B. F. STURTEVANT CO., 135 N. Third St.** (See page 33.)

ELECTRICAL GENERATORS.

5264 **B. F. STURTEVANT CO., 135 N. Third St.** (See page 33.)
C. & C. Electric Co., 633 Arch St.
Eddy Electric Mfg. Co., 506 Commerce St.
Fort Wayne Electric Corp., 101 Bourse Bldg.
General Electric Co., 509 Arch St.
4390 **KEYSTONE ELECTRIC CO., 129 S. 11th St.**
Walker Co., The, 748 Drexel Bldg.
12116 **WESTINGHOUSE ELECTRIC MFG. CO., Land Title Bldg.**

ELECTRICAL LAMPS.

BEACON LAMP CO., New Brunswick, N. J.
De Ginther, Geo. M., 1037 Walnut St.
General Electric Co., 509 Arch St.
1526 Imperial Electric Co., 719 Walnut St.
MCINTIRE, WALTER C., & CO., 506 Commerce St.
Stewart, Frank H., & Co., 35 N. Seventh St.

* ELECTRICAL MACHINERY.

See also Dynamos and Motors.

5264 **B. F. STURTEVANT CO., 135 N. Third St.** (See page 33.)
4390 **KEYSTONE ELECTRIC CO., 129 S. 11th St.**

* ELECTRICAL MOTORS.

See also Dynamos and Motors.

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

* ELECTRICAL PUMPS.

See also Pumps (Electric).

2007 DALLETT, W. P. (Deming and Buffalo Pumps), 49 N. Seventh St.
1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.
4390 KEYSTONE ELECTRIC CO., 129 S. 11th St.
4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps).
(See p. 73.)
4081 SNOW STEAM PUMP WORKS (Thos. C. McBride, Mgr.), 946 Drexel Bldg. (See p. 73.)
2041 WORTHINGTON, HENRY R., 724 Arch St.

* ELECTRICAL REPAIRS.

KENYON, FRANK C., 1840 Columbia Ave.

ELECTRICAL SUPPLIES.

Bassett, N., & Son, 625 Filbert St.
Boyle, R. C., & Co., 4603 Frankford Ave.
Bright, Evan D., 119 N. Sixth St.
Buckeye Electric Co., 552 Bourse Bldg.
Burk & Pickering, 25 N. Seventh St.
C. & C. Electric Co., 633 Arch St.
Central Electric Co., 13 N. 13th St.
Chicago Electric Wire Co. of Del., S. W. cor. Ninth and Parish Sts.
Cleverly, Henry A., 1018 Chestnut St.
Cornish Electric Bell Co., 1169 Chestnut St.
Crandell Mfg. Co., 29 Bank St.
Crosby Bros., 44 N. Fourth St.
Cutter Electric Mfg. Co., 1106 Sansom St.
DeGinther, George M., 1037 Walnut St.
Electric Protection Co., 1026 Filbert St.
Electrical Supply & Telephone Co., 1429 Chestnut St.
Electro Dynamic Co., 224 Chestnut St.
Etherington Co., 47 S. 17th St.
Flemming, Otto, 1003 Arch St.
France, A. Warren, cor. Titus St. and State Road.
Franklin, Ben., Electrical Co., 44 N. Seventh St.
Geiger, Frederick, 118 N. Sixth St.
General Electric Co., 509 Arch St.
Gwilliam, James R., 115 N. Sixth St.
Hays, Eugene D., 1215 Filbert St.
Hazleton, F. D., & Co., 1028 Filbert St.
Helios Electric Co., 1229 Callowhill St.
High Tension Electric Storage Co., 1229 Callowhill St.
Holm, Charles H., 4123 Lancaster Ave.
Imperial Electric Co., 719 Walnut St.
Jandus Electric Co., 552 Bourse Bldg.
Kelly, John E., 411 Cherry St.
Knell, Edward F., 2608 Montgomery Ave.
Large & Twining, 321 Chestnut St.
1526 McINTIRE, WALTER C., & CO., 506 Commerce St.
McDonnell, Jas. Y., Co., 122 N. Frankford St.
Mayer & England, 10 S. 10th St.
National Underground Cable Co., 609 Betz Bldg.
Novelty Electric Co., 54 N. Fourth St.
Paiste, H. T., & Co. 3101 Ludlow St.
Parke, John Y., & Co., 821 Cherry St.
12116 PATRICK, CARTER & WILKINS, 125 S. Second St.
Phila. Electric & Mfg. Co., 2010 Commerce St.
Phila. Electrical Equipment Co., 816 Cherry St.
Phila. Elec. Storage Battery Renting Co., 1004 Walnut St.
Phila. Railway Equipment Co., N. 52d St., cor. Lancaster Ave.
Pneumatic Fire Alarm & Tel. Co., Inc., 2930 Market St.
Pringle, William T., & Co., 1026 Filbert St.
Rice & Lefebvre, 23 N. 13th St.
Rumsey Electrical Manufacturers' Co., 1217 Filbert St.
Schwarz, Bernard, 1909 N. Sixth St.
Shaw, J. Elliott, & Co., 632 Arch St.
Sheble & Patton, 1028 Filbert St.
Shelby Electrical Co., 206 N. Fourth St.
Shuttleworth Electric Co., Duncan St. cor. Bermuda St., Frankford.
Sparrow, Henry A., 1229 Chestnut St.
Stadelman, H. R., 313 Franklin Bldg.
Stewart, Frank H., & Co., 25 N. Seventh St.
Strang, R. C., 723 Walnut St.
Supplee, G. A., & Co., 265 N. Ninth St.
Taylor & Clark, 510 Arch St.
Thilow, Frank B., 1123 Poplar St.
Thompson & Allen, 1303 Buttonwood St.
Valley Bros. & Co., 625 Arch St.
Walker & Kepler, 531 Chestnut St.
12116 WESTINGHOUSE ELECTRIC MFG. CO., Land Title Bldg.
Weston Electrical Instrument Co., 910 Drexel Bldg.
White, H. P., & Co., 1217 Filbert St.
Wirt, Charles S., 1028 Filbert St.

ELECTRICIANS.

Andress, Geo. D., 555 Willard St.
Arnois, Alexander, 129 S. Seventh St.
Bardsley, Richard, 2559 E. Dauphin St.
Beatty, W. H., 1100 Betz Bldg.
Bloomingdale, Alfred M., 332 Market St.
Brown, James, & Co., N. 16th St., cor. Erie Ave.
Burk & Pickering, 26 N. Seventh St.
Ciriacy, William, 461 Queen St., Germantown.
City Electric Works, 1221 N. 42d St.
Cole, S. Charles, Jr., 2357 N. 21st St.
Cornish Electric Bell Co., 1109 Chestnut St.
Cox, Charles W., 1009 New Market St.
Crager, William S., 3511 N. Fifth St.
Cram, John S., 54 N. 11th St.
Creekmore, Thos. J., 6 Mascher St.
Crouthamal, Wilson L., 1706 Frankford Ave.
Diener, Edward H., 30 N. Water St.
Elkins, Edwin, 2616 N. Bouvier St.
Engle, Alvin H., 1811 Fairmount Ave.
Etherington Co., 47 S. 17th St.
Eyanson & Armpriester, 123 N. Third St.
Feicht, Russel S., 730 N. 20th St.
Fitch, Charles P., 1217 Filbert St.
Flemming, Otto, 1009 Arch St.
Free, E. Willard, 3848 Fairmount Ave.
Freeman, Alexander J., 3321 N. Broad St.
Gardner, George W., 3088 Helen St.
Gay & Thwaites, 1113 Arch St.
Geib, Adam, 2237 Gratz St.
Gerson, Louis J., 712 Sansom St.
Gifford & Henry, 17 S. Third St.
Gliem, Frederick H., 836 N. 25th St.
Gregg, Morris M., 1029 Cambria St.
Haller & Ricketts, 1337 Susquehanna Ave.
Halstead, David, Jr., 1129 Cherry St.
Heald, Joseph, 636 N. 16th St.
Hewitt, Charles B., 310 Bullitt Bldg.
Hildebrandt, Albert, 30 N. Seventh St.
Hopson, Millard F., 2430 Christian St.
Jackson, John B., 1221 N. 42d St.
Klemt, Eugene, 648 Indiana Ave.
Largo & Twinning, 321 Chestnut St.
Lawrence, Randolph M., 2441 N. Garnet St.
Leitmeyer, Geo. J., 1753 Croskey St.
Lindeman, Max, 106 Diamond St.
Loesch, Charles A., 1714 N. 12th St.
McClintock, Charles, 1217 Filbert St.
Mahoney, J., 106 Diamond St.
Malpass, Henry, 1932 Callowhill St.
Marett, Philip W., 3448 Germantown Ave.
Marshall, Clarence L., 2201 Fairmount Ave.
Mason Bros., 56 N. Seventh St.
Mehan, Philip A., 128 S. Clifton St.
Middleton, Oscar N., 18 Harvey St., Germantown.
Morejon, Frank, 1713 N. 28th St.
Morgan, Harry E., 1830 Columbia Ave.
Moyer, Charles, 1803 N. 20th St.
Murphy, Alex., 3 N. 19th St.
National Electric Co., 1225 Filbert St.
Parker, Joseph, 26 Lafayette St., Germantown.
Porter, Herbert M., 4603 Parrish St.
Rauch, Wm. B., 881 N. 44th St.
Richter, Eugene L., 1037 Walnut St.
Robbins, Geo., Jr., 853 N. 43d St.
Rowe, Ernest L., 2142 N. 20th St.
Rowland, Horace B., Old Second St. Pk., Fox Chase.
Sanden Electric Co., 924 Chestnut St.
Schickendantz, George, 2617 N. Colorado St.
Scott & Janney, Electric and Mfg. Co., 1709 Filbert St
Shuttleworth, Geo. H., 4632 Tacony St., Frankford.
Smith, E. Willets, 934 Somerset St.
Smith, Wm. J., 201 N. 16th St.
Snyder, Wm. B., 216 Church Lane, Germantown.
Sonneberg, Walter, 2426 N. 18th St.
Sparrow, Henry A., 1229 Chestnut St.
Sterling, Lucius F., 1520 Susquehanna Ave.
Stern & Silverman, 707 Arch St.
Thilow, Frank B., 1123 Poplar St.
Thomas, William T., 2311 N. Colorado St.
Thompson & Allen, 1303 Buttonwood St.
Valentine & Co., 1 S. 10th St.
Walker, Elton G., 15 S. 3d St.
Welsh, Jos. F., 100 Ripka Ave., Manayunk.
West Phila. Electric Co., 3745 Filbert St.
Weston, Charles J., 118 N. Sixth St.
Weston, Wm. H., & Co., 1303 Buttonwood St.
White & Cook, 1018 Chestnut St.
Widmann, S., & Son, 857 N. 15th St.

ELEVATORS.

5670A Albro-Clem Elevator Co., Inc., The, Seventh St. and Glenwood Ave.
CLEM ELEVATOR WORKS, 413 Cherry St.
Elevator Safety Controller Co., 907 Girard Bldg.
Energy Mfg. Co., 411 Cherry St.
Excelsior Elevator Co., 1213 Filbert St.
Harrington Edwin, Son & Co., Inc., N. 15th St. cor. Penna. Ave.
Keystone Elevator Co., 408 Lippincott Bldg.
McCalvey Elevator Works, 602 Cherry St.
Morse, Williams & Co., 1105 Frankford Ave.
O'Neill & Currie, 411 Cherry St.
Otis Bros. & Co., 702 Bullitt Bldg.

4571 STOKES & PARRISH ELEVATOR CO., 702 Bullitt Bldg.

ELEVATORS (ELECTRIC).

Albro-Clem Elevator Co., Inc., The, Seventh St. and Glenwood Ave.
Excelsior Elevator Co., 1215 Filbert St.
4390 KEYSTONE ELECTRIC CO., 129 S. 11th St.
Morse, Williams & Co., Inc., 1105 Frankford Ave.
Otis Bros. & Co., 702 Bullitt Bldg.

4571 STOKES & PARRISH ELEVATOR CO., 702 Bullitt Bldg.

ELEVATORS (HAND POWER).

Albro-Clem Elevator Co., Inc., The, Seventh St. and Glenwood Ave.
CLEM ELEVATOR WORKS, 413 Cherry St.
Energy Mfg. Co., 411 Cherry St.
Excelsior Elevator Co., 1215 Filbert St.
McCalvey Elevator Works, 602 Cherry St.

ELIMINATORS.

6870 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See page 50-75.)
ROBERTSON, JAS. L., & SON, Betz Building. (See page 79.)

EMERY WHEELS.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

ENGINE BUILDERS AND DEALERS.

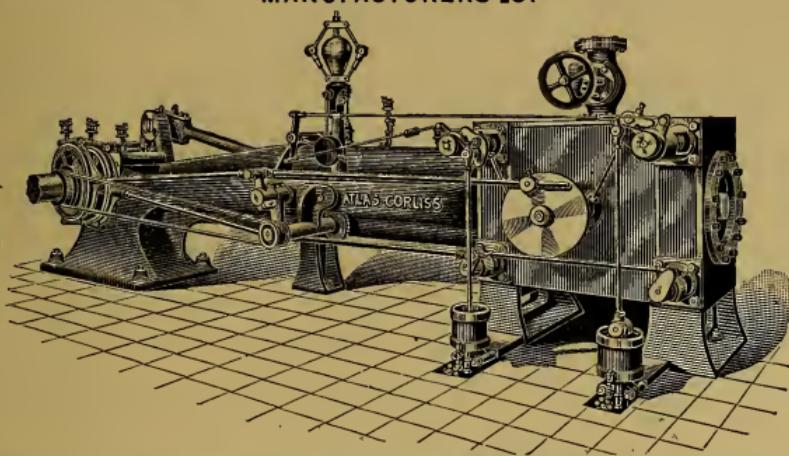
4549 ALLFREE, J. B., MFG. CO. (Penna. Machine Co., Agts.), 31 N. Seventh St.
Ames Iron Works, 511 Fidelity Bldg.
Armington & Sims Engine Co., 913 Betz Bldg.
5408 5264 ATLAS ENGINE WORKS (Lovegrove & Co., Agts.), 143 N. Third St. (See page 45.)
B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
Bailey, F. E., & Co., 913 Betz Bldg.
Baker, H. C., & Co., 333 Bourse Bldg.
Barr Pumping Engine Co., Lehigh Ave. cor. N. 18th St.
Buffalo Forge Co., 593 Bourse Bldg.
Burchfield, T. T., 55 N. Seventh St.
4549 5235A CHANDLER & TAYLOR CO. (Penna. Machine Co., Agts.), 31 N. Seventh St. (See p. 88.)
CONARD, THOS. P., 119 S. Fourth St. (See page 67.)
Corliss Engine Works, Howard cor. Huntingdon Sts.
Cox & Sons Co., 215 Race St.
Cramp, Wm. & Sons, Ship & Engine Bldg. Co., Beach and Palmer Sts.
Erie City Iron Works, 1420 Chestnut St.
Fischer Foundry & Machine Co., 30 N. Seventh St.
5363 FITCHBURG STEAM ENGINE CO., 1001 Chestnut St.
Frick Co., Machinery Dept., Bourse Bldg.
5396D FRICK, HORACE E., 421 Chestnut St. (See page 55.)
Harlan & Hollingsworth Co., The, 1107 Walnut St.
Harrisburg Foundry & Machine Works, 701 Betz Bldg.
Hillman, Chas., Ship & Engine Bldg. Co., The, Beach ab. Palmer Sts.
Holmes, John E., & Co., 612 Arch St.
Howard, Geo. C. Foundry and Machine Works, 1748 Ludlow St.
Kensington Engine Works (Ltd.), 704 Arch St.
5409 LOVEGROVE & CO., "ATLAS," 143 N. Third St. (See page 45.)
Morris, I. P., Co., Beach cor. Ball Sts.
Naylor, Jacob, Front St. cor. Girard Ave.
Neafie & Levy, Ship & Engine Bldg. Co., The, 1336 Beach St.
NEWBURGH ICE MACHINE & ENGINE CO., 1326 Chestnut St.
New York Safety Steam Power Co., 15 N. Seventh St.
Payne Engineering Co., 333 Bourse Bldg.
4549 1781 PENNA. MACHINE CO., 31 N. Seventh St. (See page 88.)
PHILADELPHIA ENGINEERING WORKS, Ltd., Mifflin cor. Meadow Sts.
PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)
Providence Steam Engine Co., 935 Drexel Bldg.
Rich, J. & G., 120 N. Sixth St.
Rider-Ericsson Engine Co., 31 N. Seventh St.
Roediger, Paul, Hot Air Engine Co., 927 Chestnut St.
ROOTS, P. H. & F. M. CO., 109 Liberty St., New York. (See insert opp. page 32.)
Sciple, H. M., & Co., 100 N. Third St.
Simpson, Wm. L., Fifth cor. Buttonwood Sts.
Southwark Foundry & Machine Co., Washington Ave., cor. Fifth St.
Vilter Mfg. Co., The, Provident Bldg.
12116 WESTINGHOUSE MACHINE CO., Land Title Bldg.
Weston Engine Co., 901 Harrison Bldg.
York Mfg. Co., 476 Bourse Bldg.

ATLAS
P. O. BOX No. 759

ENGINE WORKS.

INDIANAPOLIS, IND.

MANUFACTURERS OF



ATLAS-CORLISS ENGINE.

Plain and Automatic Side-Grant
Engines,
Plain and Automatic Flange
Engines,

Plain and Automatic Self-contained
Engines,

Plain and Automatic Heavy Duty Engines, Double Expansion Automatic Slide Valve Engines, Single and Double Expansion Cycloidal Heavy Duty Engines, Corliss Engines, Horizontal Tubular and Locomotive Flange Steel Boilers, High Pressure Horizontal Tubular Flange Steel Boilers, Internal-Fired Horizontal Tubular Flange Steel Boilers, Vertical Flange Steel Boilers, Vertical High Pressure Water Tube Safety Boilers, Horizontal High Pressure Water Tube Safety Boilers.

PHILADELPHIA AGENTS:

LOVEGROVE & CO., 143-145 N. Third Street.

Phœnix Iron Works Co.,

MEADVILLE, PA.

ENGINES AND BOILERS

We build a full line of "Automatic Cut-off Engines" from 40 to 600 Horse-power. Simple, Compound and Triple Expansion.

Return Tubular, Vertical and Horizontal Internal Furnace and Water Tube Boilers.

Send for Catalogue.

* ENGINES (AUTOMATIC).

See also Engine Builders.

5409 ATLAS ENGINE WORKS (Lovegrove & Co., Agts.), 143 N. Third St. (See page 45.)
5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
PHENIX IRON WORKS CO., Meadville, Pa. (See page 45.)

ENGINES (CORLISS).

See also Engine Builders.

5409 ATLAS ENGINE WORKS (Lovegrove & Co., Agts.), 143 N. Third St. (See page 45.)
5363 FITCHBURG STEAM ENGINE CO., 1001 Chestnut St.
1781 PHILA. ENGINEERING WORKS (Ltd.), cor. Mifflin and Meadow Sts.

ENGINES (GAS AND GASOLINE).

Climax Gas and Gasoline Engines, 68 N. Fourth St.
De La Vergne Refrigerating Machine Co., The, 704 Girard Bldg.
FAIRBANKS CO., 701 Arch St. (See front cover.)
Mast, P. P., & Co., 13th St., cor. Willow St.
OTTO GAS ENGINE WORKS, THE, 33d St., cor. Walnut St.
Penn. Iron Works Co., 50th St., cor Lancaster Ave.
Priestman & Co., Inc., Bourse Bldg.
U. S. Fuel Oil Equipment Co., 530 Bourse Bldg.
White & Middleton Gas Engine Co., Bourse Bldg.

ENGINES (HOT AIR).

Rider-Ericsson Engine Co., 31 N. Seventh St.
Roediger, Paul, Hot Air Engine Co., 927 Chestnut St.

ENGINES (PUMPING).

See also Pumps.

2007 DALLETT, W. P. (Deming and Buffalo Pumps), 49 N. Seventh St.
1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.
4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s
Pumps.) (See page 73.)
4081 SNOW STEAM PUMP WORKS (T. C. McBride, Mgr.), 946 Drexel Bldg. (See page 73.)
2041 WORTHINGTON, HENRY R., 724 Arch St.

ENGINES (SECOND HAND).

Lovegrove & Co., 143 N. Third St.
Rich, J. & G., 120 N. Sixth St.
Sciple, H. M., & Co., 100 N. Third St.

ENGINES, VOLUMETRIC (STEAM OR AIR).

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. page
82-83.)

* ENGINE OIL.

See also Oils (Lubricating).

5094 BORNE & SCRYSER CO., 223 N. Front St.
2912 LEONARD & ELLIS, 433 N. Third St.
5754 N. Y. LUBRICATING OIL CO., 319 Walnut St.
724 VACUUM OIL CO., 305 Walnut St.
5836D WILSON-CLARK CO., 107 S. Water St.

ENGINE REPAIRS.

Ruwell, Wm. F., & Co., 17th St. and Washington Ave.

ENGINE SETTING.

See also Boiler Setting.

Gear, Washington J., Jr., 12 N. Seventh St.
Hyzer, Wm. C., 1230 Marlborough St.
TAYLOR, W. H. H., & SON, Room A, Brown Bldg. (See page 35.)

* ENGINE STOPS.

"CORLISS" SPRINGFIELD ENGINE STOP CO., 275 Main St., Springfield,
Mass.

ENGINE TRIMMINGS.

LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back
cover.)

ENGINEERS' BOOKS.

See also Books, Mechanical.

AUDEL, THEO., & CO., 63 Fifth Ave., New York.
PHILADELPHIA BOOK CO., 15 S. Ninth St. (See page 36.)
POWER PUBLISHING CO., World Bldg., New York. (See page 4.)

ENGINEERS (ELECTRICAL).

Arnois, Alexander, 129 S. Seventh St.
Bailey, F. E., & Co., 913 Betz Bldg.
Buchanan, J. F., & Co., 321 Philadelphia Bourse.
Carpenter, Edward, 508 Philadelphia Bank Bldg.
Cheyney, W. Irwin, & Co., 1217 Filbert St.
Clarke, Herbert A., 741 N. 44th St.

ENGINEERS (ELECTRICAL)—Continued,

Condict, G. Herbert, 532⁵ Greene St., Germantown.
Davids, Richard W., 308 Walnut St.
Davis, Edward, 1000 Betz Bldg.
D'Oliver Engineering Co., 129 S. 11th St.
Falkenau Engineering Co., Ltd., 711 Terminal Bldg.
Gaylord, J. Paul, 313 Mutual Life Bldg.
Gilpin, Richard, 421 Chestnut St.
Henderson, William C., 1712 Market St.
Hering, Carl, 929 Chestnut St.
Hewes, James Ellicott, 412 Philadelphia Bank Bldg.
Hibbert, Walter W., 415 Hale Bldg.
Hochrath, Frederick H., 504 Philadelphia Bank Bldg.
Hoskin, John, 308 Walnut St.
Houston & Kennelly, 1208 Crozer Bldg.
Houston, E. J., 1203 Crozer Bldg.
Kates, L. S., 1022 Arch St.
Kennedy, Charles W., 44 N. Fourth St.
Kelly, Herbert P., 44 N. Fourth St.
Levis, Minford, 53 N. Fourth St.
Martin, Joseph J., 47 S. 17th St.
Morris & Salom, 926 Drexel Bldg.
Muckle, M. R., Jr., & Co., 650 Drexel Bldg.
Nurath, Morris M., 1512 Diamond St.
Nusbaum, Elias, 313 Mutual Life Bldg.
Pepper & Register, 1414 S. Penn Sq.
Pringle, Wm. T., & Co., 1028 Filbert St.
Rowe, Ernest L., 2142 N. 20th St.
Schramm, H. G., 602 N. Second St., Camden, N. J.
Sawyer Electrical Co., 1308 Arch St.
Schultz, Lewis Rodman, 313 Mutual Life Bldg.
Scott, Egan A., 658 Philadelphia Bourse.
Smedhurst & Allen, 1222 Stephen Girard Bldg.
Virginia Electrical Engineering Co., 119 S. 17th St.
Wirt, Chas., 1028 Filbert St.
Wood, Wm. M., 635 Walnut St.
Woodward, C. W., 840 Drexel Bldg.

ENGINEERS (MECHANICAL).

Barr, Wm. M., 112 N. Broad St.
Batcheller, B. C., 917 Girard Bldg.
Bertolette, Chester, 206 S. Fourth St.
Berryman, James, 125 N. Fourth St.
Birkbene, Henry, 36 S. Third St.
Blanton Patents Syndicate, Ltd., 554 Philadelphia Bourse.
Bonsack, Jas. A., 314 Hale Bldg.
Bormann, Herman, 2321 Master St.
Breed, George, 302 Girard Bldg.
Brooks, Arthur G., 619 Walnut St.
Brown, Edward, 311 Walnut St.
Burhorn & Granger, 1003 Stephen Girard Bldg.
Buzby, C. Ernest, 4721 Chester Ave.
Cruse, Arthur R., 39 Laurel St.
2009 DALLETT, W. P., 49 N. Seventh St.
Davies Bros. & Hartman, 1233 N. Front St.
Deppert, R. U., 542 Penn St.
Dock, Herman, 904 N. Broad St.
Edgerton, Charles, 702 Fidelity Bldg.
Engstrom, Alex H., 572 Bullitt Bldg.
6963 EYNON-EVANS MFG. CO., THE, 15th St. cor. Clearfield St. (See page 58.)
Fagan, John L., 126 W. Penn St., Germantown.
Falkenau Engineering Co., Ltd., 711 Terminal Bldg.
Forte, Henry L., 536 Drexel Bldg.
Fothergill, H. Robinson, 914 Betz Bldg.
Francis, Henry B., 1217 N. 10th St.
5396D FRICK, HORACE E., 421 Chestnut St. (See page 55.)
Geshwind, Herbert W., 1215 Filbert St.
5264 GIFFORD, C. H., & CO., 135 N. Third St.
Gill, John L. Jr., 608 Drexel Bldg.
Gill, John L., 3d, 608 Drexel Bldg.
Haig, Andrew H., 249 S. American St.
Haug, John, 206 Walnut Pl.
Heckendorf, Henry C., 224 Morris St.
Hellstrom, Magnus, 572 Bullitt Bldg.
Henderson, William M., 4420 Chestnut St.
Herr, Homer A., 441 Chestnut St.
Hess & Barker, 810 Sansom St.
Holmes, Frederick S., 624 Philadelphia Bourse.
Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.
Howell, Edward I. H., 771 Bullitt Bldg.
Kitson, Arthur, 1050 Drexel Bldg.
Lalor, James D., 636 Arch St.
Linch, Chas. S., 935 Drexel Bldg.
Link Belt Engineering Co. (The), Hunting Park Ave., Nicetown.
Meyer, John H., 325 Walnut St.
Meyers, Geo. O., 1254 Hanover St.
Monroe, Edwin P., 1345 Arch St.
Morris, Henry G., 926 Drexel Bldg.
Muckle, M. R., Jr., & Co., 650 Drexel Bldg.

ENGINEERS (MECHANICAL)—Continued.

Naylor, Jacob, Front St. cor. Girard Ave.
Newhall, Geo. M., Engineering Co., Ltd., 136 S. Fourth St.
Pfautz, Daniel M., 113 N. 12th St.
Price, George B., 1200 Chestnut St.
Rippey, S. H., 537 Bourse Bldg.
Roberts, Frank C., & Co., 328 Chestnut St.
Robinson, Wm. H., 1012 Betz Bldg.
Schramm, H. G., 602 N. Second St., Camden, N. J.
Schutte, L., & Co., 12th St. cor. Thompson St.
Simpson, Wm. L., Fifth and Buttonwood Sts.
Stein & Boericke, Ltd., 325 Walnut St.
Stillwell, Chas. B., Witherspoon Bldg.
Thompson, Chas. T., 426 Walnut St.
Thompson, Samuel K., 915 Somerset St.
Wheeler, S. Bowman, 807 Girard Bldg.
Whipple, F. E., 1218 Filbert St.
White, Ernest M., 619 Walnut St.
Wiegand, S. Lloyd, 615 Walnut St.

ENGINEERS' SPECIALTIES.

Brogan & Co., 810 Race St.
CRANE CO., 220-222 So. Fifth St. (See page 79.)
DANIEL, C. A., 409 Market St. (See insert opp. page 10.)
EYNON-EVANS MFG. CO., THE, 15th and Clearfield Sts. (See page 58.)
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
France, A. W., Tacoma, Pa.
GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
Haines, Wm. S., Co., 136 S. Fourth St.
HUYETTE, PAUL B., 1213 Betz Bldg. (See page 2.)
JENKINS BROS., 117 N. Fourth St. (See inside front cover.)
Keystone Engine and Machine Works, cor. Fifth and Buttonwood Sts.
Lonergan, J. E., & Co., 211 Race St.
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)
Shaw, T., M. E., 915 Ridge Ave.
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
Schutte, L., & Co., 12th St. cor. Thompson St.
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

ENGINEERS' SUPPLIES.

Allen, E., & Co., 5010 Lancaster Ave.
Bell, Harry E., 201 Church St.
Bergtresser, S., 50 N. 23d St.
Billau & Cochrane, 527 Commerce St.
Blackburn, S. P., & Co., 129 S. Second St.
Bowen & Martin, 118 S. Second St.
BOYD, JAMES & BRO., 14 N. Fourth St. (See insert opp. page 57.)
Bullock, Chas. K., 1361 Ridge Ave.
CRANE CO., 220-222 S. Fifth St. (See page 79.)
DANIEL, C. A., 409 Market St. (See insert opp. page 10.)
Bickerton, T. B., & Co., 23 N. Sixth St.
Elsweiler, Wm., 230 N. Third St.
EYNON-EVANS MFG. CO., THE, 15th and Clearfield Sts. (See page 58.)
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
Glazier, Wm. H., 1802 Filbert St.
GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
Gwilliam, Jas. B., 115 N. Sixth St.
Haliburton, C. J., 217 Walnut St.
Hunter & Dicson, 243 Arch St.
JENKINS BROS., 117 N. Fourth St. (See inside front cover.)
Keating, Geo. P., 509 North St.
KEYSTONE LUBRICATING CO., 20th St. cor. Allegheny Ave. (See page 56.)
Lonergan, J. E., & Co., 211 Race St.
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)
Nice, H. N., & Bro., 1215 Filbert St.
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
Peirce, Edwin L., 245 Market St.
Penn Engineering Co., 312 Cherry St.
Fowell & Maddock, 40 N. Sixth St.
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
Smith, Jas., & Co., Inc., 413 Race St.
Spaulding & Metcalf, 52 Arch St.
Vance, Jas. M., & Co., 211 Market St.
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)
Webb, Edward G., 58 N. Fourth St.
Williamson & Cassedy, 526 Market St.

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EXHAUST FANS AND BLOWERS.

See also Blowers.

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
LEE, THOMAS, 209-213 Race St., Cincinnati, O. (See page 49.)

EXHAUST HEADS.

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
Bingham & Co., 232 Cherry St.
6963 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)
4585 GRIFFING, A. A., IRON CO. "BUNDY," 702 Arch St.
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
Keystone Engine and Machine Works, Fifth and Buttonwood Sts.
5702 LEE, THOMAS, 201-203 Race St., Cincinnati, O. (See page 49.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

EXTRACTORS (GREASE).

4585 GRIFFING, A. A., IRON CO. "BUNDY," 702 Arch St.
6870 HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave.
(See pages 50-75.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

REDUCE YOUR COAL BILLS

By Putting Your Water in the Boiler at Boiling Point.

THE OTIS

TUBULAR FEED WATER HEATER AND PURIFIER

WITH SEAMLESS BRASS TUBES.

OUR STANDARD HEATERS ARE
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See also Electrical Supplies.

5264 **B. F. STURTEVANT CO., 135 N. Third St.** (See page 33.)

Burk & Pickering, 26 N. Seventh St.
C. & C. Electric Co., 638 Arch St.
Central Electric Co., 18 N. 13th St.
Cheyney, W. Irwin, & Co., 1217 Filbert St.
Diener, E. H., 30 N. Water St.
Etherington Co., 47 S. 17th St.
Kenyon, Frank C., 1840 Columbia Ave.
McDonald, Davis & Co., 2055 Ridge Ave.

1526 **MCINTIRE, WALTER C., & CO., 506 Commerce St.**

Pringle, Wm. T., & Co., 1028 Filbert St.
Richter, E. L., 2349 N. 15th St.
Stewart, Frank H., & Co., 35 N. Seventh St.
Strang, R. C., 723 Walnut St.
Supplee, G. A., & Co., 265 N. Ninth St.
Vallee Bros. & Co., 625 Arch St.
Walker & Kepler, 531 Chestnut St.

FANS (VENTILATING AND PRESSURE).

5264 **B. F. STURTEVANT CO., 135 N. Third St.** (See page 33.)

FEED WATER HEATERS AND PURIFIERS.

Berryman Heater & Purifier, The, 125 N. Fourth St.

BONAK, JAMES, & CO., Carnegie Bldg., Pittsburgh, Pa.

Buchfield, T. T., 55 N. Seventh St.

GOUBERT MFG. CO. (THE), 14-16 Church St., New York.

GRIFFING, A. A., IRON CO. "BUNDY," 702 Arch St.

HARRISBURG PIPE BENDING CO. (Ltd.), 752 Herr St., Harrisburg, Pa. (See page 51.)

6870 **HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave.** (See pages 50-75.)

Hoppes Mfg. Co., 604 Girard Bldg.

Kensington Engine Works (Ltd.), 704 Arch St.

PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

Simpson, Wm. L., cor. Fifth and Buttonwood Sts.

STEWART HEATER CO., 51 Norfolk Ave., Buffalo, N. Y. (See page 49.)

1216 **STILWELL-BIERCE & SMITH VAILE CO., THE (P. B. Fenlon, Mgr.), 612 Arch St.**

Webster, Warren & Co., Stephen Girard Bldg.

* FEED WATER REGULATORS.

HUYETTE, PAUL B., 1213 Betz Bldg. (See page 2.)

FILTERS.

Binder, G., & Co., 443-445 N. 10th St.

Kensington Engine Works (Ltd.), 704 Arch St.

Loomis-Manning Filter Co., 402 Chestnut St.

MORRISON-JEWELL FILTRATION CO., 26 S. 15th St.

New York Filter Mfg. Co., 724 Arch St.

Simpson, Wm. L., cor. Fifth and Buttonwood Sts.

Wanner, Louis, Engineering Co., 106 N. Sixth St.

Weaver Filter Mfg. Co. (Ltd.), The, 532 Arch St.

FIRE ALARMS.

6374 **BENNETT, H. R., 1217 Filbert St.** (See page 52.)

Pneumatic Fire Alarm Telegraph Co., 809 Girard Bldg.

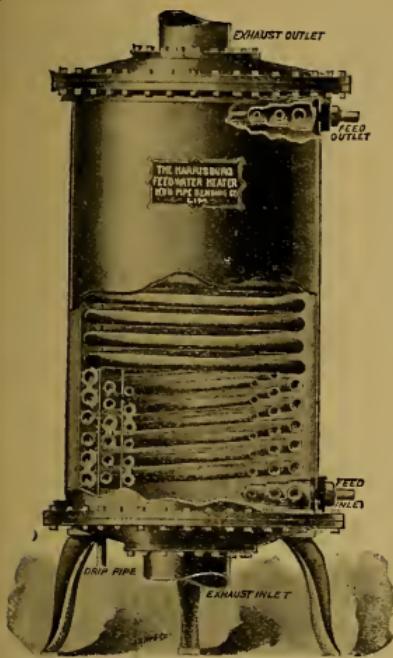
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FIRE DEPARTMENT SUPPLIES.

6374 BENNETT, H. R., 1217 Filbert St. (See page 52.)
4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 Clay, John H., 1320 Ridge Ave.
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
Latta & Mulconroy, 1217 Market St.
Shannon Mfg. Co., cor. 11th and Catherine Sts.

FIRE EXTINGUISHERS.

Automatic Fire Extinguisher Co. (Ltd.), 112 S. Orianna St.
Babcock Fire Extinguisher Co., 14 N. Fourth St.
6374 BENNETT, H. R., "STEMPLE," 1217 Filbert St. (See page 52.)
4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
Clay, John H., 1320 Ridge Ave.
Francis Bros. & Jellett, 704 Arch St.
General Fire Extinguisher Co., 1001 Chestnut St.
Lierz & Siegmund, 907 Arch St.
Miller Fire Extinguisher Co., 369 Bourse Bldg.
6374 STEMPEL FIRE EXTINGUISHER MFG. CO. (H. R. Bennett), 1217 Filbert St.
(See page 52.)
Universal Automatic Fire Extinguisher Co. (Ltd.), 2627 Howard St.

FIRE HOSE.

See also Hose.

4747 BOSTON BELTING CO., 14 N. Fourth St. (See insert opp. page 57.)
4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., N. Y. (See inserts opp. pages 68-69.)
765 QUAKER CITY RUBBER CO., 409 Market St. (See insert opp. page 10.)

FIRE HOSE (LINEN).

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)

FLEXIBLE SHAFTS.

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* FLOAT VALVES.

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ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

STEWART HEATER CO., 51 Norfolk Ave., Buffalo, N. Y. (See page 49.)

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

FORGES (PORTABLE AND STATIONARY).

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

ROOTS, P. H. & F. M., CO., 109 Liberty St., New York. (See insert opp. page 32.)

* FOUNDERS (BRASS).

See also Brass Founders.

EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)

A DOLLAR SAVED IS A DOLLAR EARNED. USE THE "NIAGARA" BOILER TUBE CLEANER.

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See also Iron Founders.

6870 EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)
HARRISON SAFETY BOILER WORKS, 17th St., bel. Allegheny Ave. (See pages 50-75.)

FRICITION CLUTCHES.

6805 CRESSON, GEO. V., CO., cor. 18th St. and Allegheny Ave.
Link Belt Engineering Co., The, Hunting Park Ave., Nicetown.
Moore & White Co., cor. 15th St. and Lehigh Ave.
Smith, James, & Co., Inc., 411 Race St.

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FUEL ECONOMIZER CO., THE, "GREENS," Matteawan, N. Y.
Kensington Engine Works, Ltd., 704 Arch St.

FURNACE GRATES.

5396D FRICK, HORACE E., 421 Chestnut St. (See page 55.)
1111 HAWLEY-DOWN DRAFT FURNACE CO. OF PENNA., 720 Girard Bldg.
McCLAVE, BROOKS & CO., 466 Bourse Bldg. (See page 54.)
SALAMANDER GRATE BAR CO., 128 Liberty St., New York.

FURNACES (SMOKELESS).

4004 COLUMBIA STOKER CO., THE, 1001 Chestnut St.
Davis Automatic Stoker Co., Bridgeport, Pa.
1111 HAWLEY-DOWN DRAFT FURNACE CO. OF PENNA., 720 Girard Bldg.
Kensington Engine Works, Ltd., 704 Arch St.
6040 WILKINSON MFG. CO., 1107 Stephen Girard Bldg. (See page 81.)

GALVANIZED EXHAUST PIPING.

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

GAS ENGINES.

See also Engines, Gas.

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
8107 OTTO GAS ENGINE WORKS, THE, 33d St. cor. Walnut St.

GAS EXHAUSTERS.

ROOTS, P. H. & F. M., CO., 109 Liberty St., New York. (See insert opp. page 32.)

GASKETS.

4747 BOSTON BELTING CO., 14 N. Fourth St. (See insert opp. page 57.)
4747 BOYD, JAMES & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
5040 GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
429 Camden N. J. ASBESTOS CO., 117 N. Front St., Camden, N. J. (See page 31.)
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)

GASKETS (VULCABESTON).

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

GATE VALVES.

See also Valves, Gate.

1760 CRANE CO., 220-222 S. Fifth St. (See page 79.)
1514 DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

GAUGE COCKS.

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HUYETTE, PAUL B., 1213 Betz Bldg. (See page 2.)
Middleton, Howard W., Co., The, 945 Ridge Ave.
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
5702 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

GAUGE GLASSES.

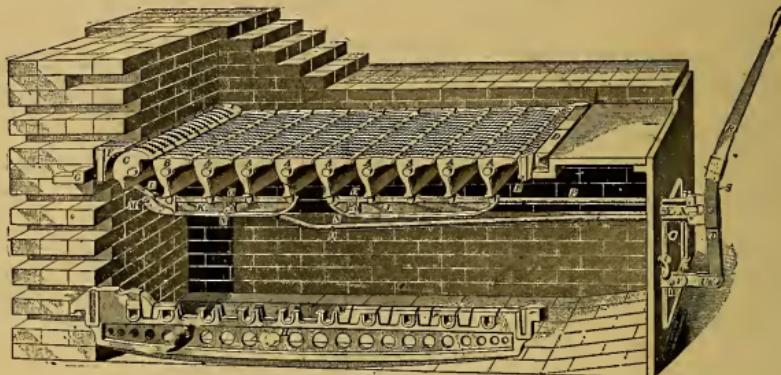
4747 BOYD, JAS., & BRO., 14 N. Fourth St. (See insert opp. page 57.)

GAUGES.

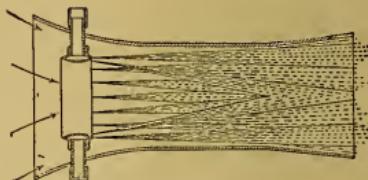
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Brown, Edward, 311 Walnut St.
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
Ford & Kendig Co., 27 N. Seventh St.
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
Shaw, T., M. E., 915 Ridge Ave.
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
Shipley, Walter C., 24 S. Seventh St.
Williamson & Cassedy, 526 Market St.

McCLAVE'S IMPROVED GRATE AND ARGAND STEAM BLOWER

FOR BOILER AND OTHER FURNACES. These appliances together combine more valuable features for burning the smaller sizes of hard and soft coal culm, birdseye, buckwheat, slack, duff, etc., than any other system. The Grate alone stands unequaled for burning the larger sizes of these fuels, with natural draught.



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The distinctive features of this grate are, that during one operation it forms pockets and cuts off and drops into the ash pit a fixed quantity of ashes at each movement, and during another operation it furnishes a thorough shaking movement without any increase in the size of the openings between the bars, and therefore without waste of fuel. In addition to these, each row of bars is divided into two sections, which permits the front half and rear half of the fire to be cleaned separately when occasion requires, i. e. when the fuel forms very large clinkers. Each row of bars, however, can be operated as a whole by means of the twin levers and double socketed operating handle. For full particulars send for Illustrated Descriptive Catalogue.

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CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

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ASHTON VALVE CO., THE, 273 Franklin St., Boston, Mass.
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

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1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

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6805 CRESSON, GEO. V., & CO., 18th St. cor. Allegheny Ave.

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5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

Eddy Electric Mfg. Co., 506 Commerce St.

Fort Wayne Electric Corporation, Bourse Bldg.

General Electric Co., 509 Arch St.

Walker Co., 748 Drexel Bldg.

12116 WESTINGHOUSE ELECTRIC & MFG. CO., Land Title Bldg.

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Rogers' Patent Grate

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6963 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

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1531 Detroit Graphite Mfg. Co., 1112 Betz Bldg.

DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)
Holmes Fibre Graphite Mfg. Co., cor. Bristol and N. 29th Sts.

Phila. Graphite Co., 802 Lippincott Bldg.

* GRAPHITE PAINT.

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Dermitt, S. W., Co., Ltd., 137 S. 10th St.

FRICK, HORACE E., 421 Chestnut St. (See page 55.)

Kline, Chas. B., 331 N. Fourth St.

McAdams, Jno. A., 723 Richmond St.

McCLAVE, BROOKS & CO., 466 Bourse Bldg. (See page 54.)

Mershon Patent Shaking Grate Works, 1203 Filbert St.

Reagan Grate Bar Co., 1026 Filbert St.

ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)

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Rose Patent Grate Co., 700 Fidelity Bldg.

St. John, Frank Jay, 308 Walnut St.

SALAMANDER GRATE BAR CO., 126 Liberty St., New York.

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GREASE CUPS.

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France, A. W., Tacony, Pa.

KEYSTONE LUBRICATING CO., cor. 20th St. and Allegheny Ave. (See page 56.)

Lonergan, J. E., & Co., 211 Racé St.

LUNKEHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58, and back cover.)

ROBERTSON, JAS. L., & SONS., Betz Bldg. (See page 79.)

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6870 HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-75.)
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)

GREASES (GRAPHITE MACHINE).

1531 DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)

GREASES (LUBRICATING).

5094 BORNE-SCRYMSER CO., 223 N. Front St.
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France, A. W., Tacony, Pa.
Frick, Nathan, & Co., 262 N. Fourth St.
Haugh, John, & Co., 111 S. Water St.
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KEYSTONE LUBRICATING CO., cor. N. 20th St. and Allegheny Ave. (See page 56.)
2912 LEONARD & ELLIS, 433 N. Third St.
Loos & Dilworth, 38 N. Delaware Ave.
5754 N. Y. LUBRICATING OIL CO., 319 Walnut St.
Skipton, Valentine, Co., 2321-2323 N. 30th St.
724 VACUUM OIL CO., 305 Walnut St.
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HAIR AND WOOL FELT.

1633 JOHNS, H. W., MFG. CO., 170-172 N. Fourth St.

* HEATERS (FEED WATER).

See also Feed Water Heaters.

6870 HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-75.)

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5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
Francis Bros. & Jellett, 704 Arch St.
1527 SMITH, H. B., CO., THE, 510 Arch St. (See page 77.)

HOISTING MACHINERY.

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Lidgerwood Mfg. Co., 15 N. Seventh St.
Link Belt Engineering Co., Hunting Park Ave., Nicetown.
1827 SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)

HOSE.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
Clay, John H., 1320 Ridge Ave.
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
Etsweiler, Wm., 230 N. Third St.
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)
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Penn Rubber Co., 608 Arch St.

QUAKER CITY RUBBER CO., 409 Market St. (See insert opp. page 10.)

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765

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4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)

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4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)

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4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)

* HOSE (STEAM).

4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)

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See also Packing (Hydraulic).

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765

DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)

5040

GARLOCK PACKING CO., 28 N. Fourth St. (See insert opp. page 11.)

MABBS HYDRAULIC PACKING CO., Box 829, Chicago, Ill. (See page 57.)

PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)

* HYDRAULIC PUMPS.

See also Pumps.

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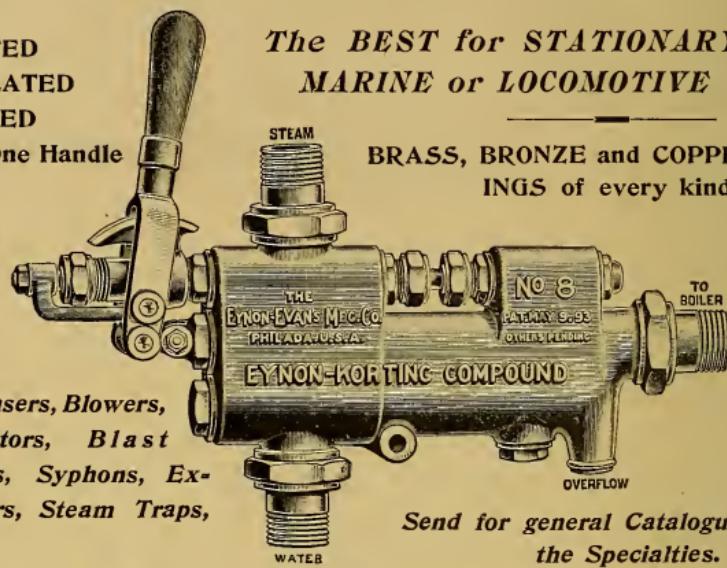
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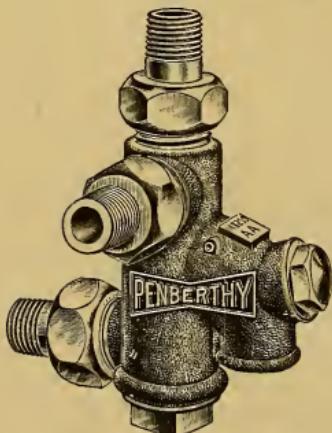
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3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

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York Mfg. Co., 476 Bourse Bldg.

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Williamson & Cassedy, 526 Market St.

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Champion & Keystone Injectors, 513 N. 12th St.

6963 EYNON-EVANS MFG. CO., THE, "EYNON-KORTING COMPOUND," cor. 15th and Clearfield Sts. (See page 58.)

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

5363 FITCHBURG STEAM ENGINE CO., 1001 Chestnut St.

Griffiths, Jas. A., 513 N. 12th St.

826 JENKINS BROS., "SELLERS RESTARTING," 117 N. Fourth St. (See inside front cover.)

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LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)

ROBERTSON, JAMES L., & SON, Betz Bldg. (See page 79.)

Rue Mfg. Co., 215 Race St.

1827 SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

Shuttle, L., & Co., cor. 12th and Thompson Sts.

* INJECTORS (BOILER OIL).

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

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Flagg, Stanley G., & Co., 19th St. cor. Pennsylvania Ave.
Florence Iron Works, 400 Chestnut St.

5396D FRICK, HORACE E., 421 Chestnut St. (See page 55.)
Girard Iron Works, 22d St. cor. Master St.
Glover Bros., Vandike St. cor. Paul St., Frankford.
Gray's Ferry Foundry & Boiler Co., Ltd., The, 1215 Filbert St.
Greger, A. L., & Co., Third St. cor. Cambridge St.
Harrisburg Foundry and Machine Works, 701 Betz Bldg.

6870 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See pages 50-75.)

Hope Iron Foundry, 960 N. Ninth St.
Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.
Jones & Scullin, Cambria St. cor. American St.
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Phila. Roll & Machine Co., cor. 23d St. and Washington Ave.
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Tacony Iron & Metal Co., State Rd., Tacony.
Thompson, J., & Co., cor. Sophia and Van Horn Sts.
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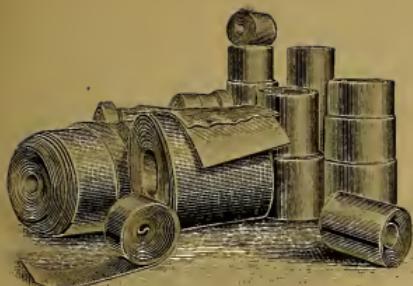
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Chester Pipe & Tube Co., 267 S. Fourth St.
Conshohocken Tube Works, 434 Drexel Bldg.

1760 CRANE CO., 220-222 S. Fifth St. (See page 79.)

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

Flagg, Stanley G., & Co., cor. 19th and Hamilton Sts.
Ford & Kendig Co., 27 N. Seventh St.
Getze & Bro., 507 Arch St.
Hunter & Dickson, 245 Arch St.
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Maneely, John, 309 Arch St.
Morris, Tasker & Co., Inc., 224 S. Third St.
National Structural Tubing Co., 552 Bullitt Bldg.
Obdyke, W. Austin, & Co., 218 New St.
Pancoast, Henry B., & Co., 243 S. Third St.
Penna. Tube Works, Fidelity Bldg.
Phila. Pipe Bending Works, Rising Sun La. and N. P. R. R.
Whetstone & Co., 911 Filbert St.
Wood, R. D., & Co., 400 Chestnut St.



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4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
Shultz Belting Co. (A. M. McComb, Mgr.), 116 N. Third St.
Town & Bro., 607 Market St.

LATHES (ENGINE AND FOOT-POWER).

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

LEATHER BELTING.

See also Belting.

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Arny, C. W., & Son, 228 N. Third St.

Bowen & Martin, 112 S. Second St.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
Danforth Belting Co., 221 Chestnut St.

765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
Etsweiler, Wm., 230 N. Third St.

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

4816 GRATON & KNIGHT MFG. CO., 132 N. Third St. (See page 61.)

Latta & Mulconroy, 1217 Market St.

Main Belting Co., 1225 Carpenter St.

Munson, Chas., Belting Co., 118 N. Fourth St.

Pancoast, Henry B., & Co., 243 S. Third St.

Pechin-Lesher Co., Ltd., 124 N. Third St.

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PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

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Richie, Crawford & Co., 420 N. Third St.

Schieren, Chas. A., & Co., 226 N. Third St.

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Smith, Jas., & Co., Inc., 411 Race St.

Webb, Edward G., 58 N. Fourth St.

Williamson & Cassedy, 526 Market St.

Wise & Bailey, 141 Market St.

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See also Belting.

4816 GRATON & KNIGHT MFG. CO., 132 N. Third St. (See page 61.)

***LEATHER PRESERVATIVE.**

CLING-SURFACE MFG. CO., 169-174 Virginia St., Buffalo, N. Y. (See insert opp. page 32.)

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4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
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LISTS OF POWER PLANTS AND ENGINEERS.

REFERENCE PUBLISHING CO., World Building, New York. (See page 30.)

LUBRICATING COMPOUNDS.

See also Oils (Lubricating).

1531 Delaware Lubricating Oil Refinery, 1214 Filbert St.
DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)
Haugh, John, & Co., 111 S. Water St.
KEYSTONE LUBRICATING CO., cor. 20th St. and Allegheny Ave. (See page 56.)
Leonard & Ellis, 433 N. Third St.
Loos & Dilworth, 38 N. Delaware Ave.
New York Lubricating Oil Co., r. 319 Walnut St.

LUBRICATING GRAPHITE.

1531 DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)

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Lonergan, J. E., & Co., 211 Race St.
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

* MACHINERY (PUMPING).

1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.

* MACHINE TOOLS.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)
1827 SELLERS, WM., & CO., Inc., 1500 Hamilton St. (See page 59.)

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Clemens, Francis, 2402 Hope St.
Climax Machine Co., Inc., 68 N. Fourth St.
Cohen, Sammel B., 706 S. Fifth St.
Colket, George H., & Co., 1516 Spring Garden St.
Collins, George, 2638 Coral St.
Cooper, Dyer, 617 Galloway St.
Corliss Engine Works, 2601 N. Howard St.
CRESSON, GEO. V., CO., N. 18th St., cor. Allegheny Ave.
Dallett, Thomas H., & Co., York St., cor Sedgley Ave.
Deissler, P., & Bro., 624 Filbert St.

MACHINISTS—Continued.

Denn & Cocker, 2009 Oxford St., Frankford.
Deweese, John W., 33 N. Seventh St.
Dieneit & Eisenhardt, 1304-1318 Howard St.
Dill, T. C., Macchine Co., Mascher St. cor. Somerset St.
Dulifus, Alphonse E., Venango St. cor. G St.
Donnelly, Joseph C., 427 N. 13th St.
Douglas, Charles G., 623 Filbert St.
Drolet, Charles, 615 Walnut St.
Duffy, Anthony, 1909 Hoffman St.
Eccles, James, 2424 Amber St.
Eldridge, F. Howard, 711 Spring Garden St.
Ellison Bros., 2218 Bridge St., Frankford.
Engel, Robert, 338 N. 11th St.
Eppler, John, 629 Filbert St.
Evans's, John, Sons, 506 N. 13th St.
Exchange Machine Works, 624 Filbert St.
EYNON-EVANS MFG. CO., THE, cor. Clearfield and 15th Sts. (See page 58.)
Fairmount Machine Co., 2106 Wood St.
Falkenau, Arthur, cor. 11th St. and Ridge Ave.
Federschmidt, Frank, 267 S. 20th St.
Fellenbaum, Harry, 431 N. Orianna St.
Ford Bros. & Co., 243-245 S. Front St.
Fordham, Walter, 4232 Main St., Manayunk.
Frame, Gibbons, Diamond St. cor. N. Second St.
Franklin Machine Works, 32 N. Fifth St.
Fullard, William, 626 Filbert St.
Gleason's, John, Sons, Diamond St. cor N. Second St.
Gleason, E. & F., cor. Susquehanna Ave. and American St.
Gleckler, Frank S., 864 Randolph St.
Goldner, Henry, & Son, Tasker Street Wharf.
Globe Machine Works, 2009 Oxford St., Frankford.
Gordon, William J., 235 Bread St.
Grant, Geo. B., 624 Race St.
Haggenmiller, Terence, 827 N. Fourth St.
Halton, Thomas, 2627 Mutter St.
Hankey, A., & Co., Inc., 2235 Vine St.
Harman Bros., 3008 Federal St.
Harrington, Edwin, Son & Co., Inc., N. 15th St. cor. Pennsylvania Ave.
Harrison's, William H., Sons, 1708 Ludlow St.
Hart, Charles, 4617 Hedge St., Frankford.
Haslam, William, 812 Race St.
Hepworth, J. W., & Co., Lehigh Ave. cor. Mascher St.
Hess & Barker, 810 Sansom St.
Hess Machine Works, 2512 Callowhill St.
Heydrick, William H. H., Benezet St. cor. P. & R. R., C. Hill
Hill, Frank K., 1306 Race St.
Himmelspach & Son, 1845 E. Hazzard St.
Hindemyer, Joseph, & Son, 911 Vine St.
Hood, R. H., 1420 Callowhill St.
Hortz, Jacob, 2040 Westmoreland St.
Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.
Ibbotson, Arthur T., 1735 Federal St.
Ingram, Amer F., 1502 N. Fifth St.
Insinger Co., Stenton Ave. near Wayne Junc., Germantown.
Inventors' Manufacturing Co., 44 N. Fourth St.
Jackson's Machine and Iron Works, 844 S. Swanson St.
Jensen-Borresen Co., 249 S. American St.
Jerram, Charles, 2826 Rosehill St.
Jesson, John B., 208 New St.
Jopes, Lewis, N. Edgewood St. cor. Media St.
Kaltenthaler, Henry J., 236 Cherry St.
Kay, William, 718 S. Mole St.
Kensington Engine Works, Ltd., 704 Arch St.
Kensington Machine Co., 2237 N. Front St.
Kerr, John J., 265 S. 11th St.
Kettler, Herman, 322 Girard Ave.
Keystone Clutch and Machine Works, 1708 Germantown Ave.
Keystone Engine and Machine Works, N. Fifth St. cor. Buttonwood St.
King, Oscar B., 923 Filbert St. and 921 Commerce St.
Klein, Charles C., 2850 N. Marshall St.
Klenk, John, r 413 Cherry St.
Koenig, Julius, 238 Bainbridge St.
Knuen, Nicholas M., 1320 Point Breeze Ave.
Knuen, Wm., 2503 N. Carlisle St.
Lake Bros., 1645 N. 10th St.
Lampe & Bartels, 117 N. Front St.
Langston, O. S., 501 Locust St.
Lee, Walter T., 120 N. Seventh St.
Lefébvre, Henry, 315 Vine St.
Lehmann, Christian, 1218 Mascher St.
Lever & Grundy, Lehigh Ave. nr. Mascher St.
Leyboldt, Frederick W., 243 N. Fifth St.
Lindley, George, Jr., 5120 Wakefield St., Germantown.
Lindsay, Hyde & Co., 213 E. York St.
Lodge, J., & Son, 103 S. Orianna St.
Loehnchen, Carl, 2630 Oakdale St.
Lusse Bros., 1034 N. Fourth St.
Lutner, William, 1603 S. Front St.

MACHINISTS—Continued.

Lyons, Charles H., r 625 Commerce St.
McCutcheon, John G., 1058 Germantown Ave.
McFarlane, George A., 1005 S. Second St.
McMahon, John, 2542 N. Fourth St.
McMichael, Abner, 22 Armat St., Germantown.
McMillan, Frank, 5432 Tacony St., Frankford.
MacFeeeters, Daniel J., cor. Eastwick Ave. and 92d St.
Manayunk Machine Works, Ring St. nr. Main St., Manayunk.
Maris Bros., S. 56th St. cor. Grays Ave.
Martino, Joseph, 1003 Noble St.
Mason, A., 420 Addison St.
Mayall, Louis A., 731 Ludlow St.
Metzger, Alfred, 33 Armat St., Germantown.
Middleton, Edward H., 4527 Hedge St., Frankford.
Miller, E. L., Co., 736 Sansom St.
Mills, Thomas, & Son, 1301 N. Eighth St.
Mitchell, John, 2224 Vine St.
Moore & White Co., Lehigh Ave. cor. N. 15th St.
Morgee, John B., 311 S. Lawrence St.
Morris, P. Hollingsworth, 1501 S. Front St.
Munion & Co., 1619 S. 22d St.
Murray, William, 2740 N. Broad St.
Nacke's Sons, 723 Sansom St.
Naylor, Jacob, Front St. cor. Girard Ave.
Newton Machine Tool Works, 2337 Vine St.
Noble, Henry A., 203 Dock St.
Oldham, George & Son, 4326 Tackawanna, Frankford.
Olsen, Tinus & Co., 500 N. 12th St.
Opie, Samuel T., 1725 Passyunk Ave.
Orr & Hess Machine Co., Ltd., 2321 Vine St.
Orton, Robert, 2140 N. Leithgow St.
Orum, Morris L., 503 N. 11th St.
Osborn, Wm., 1129 Snyder Ave.
Ott, George F., 207 to 213 Buttonwood St.
Parkham, Charles, 712 Cherry St.
Parker, S., & Son, 167 E. Chelten Ave., Germantown.
Paxton & O'Neill, 129 Bread St.
Pedrick & Ayer Co., 1001 Hamilton St.
Pemmllein, Frank, Jr., 108 E. Indiana St.
Ramsden, Israel, 1213 Day St.
Rehfuss, George, & Sons, 1311 S. Carlisle St.
Reid, Robert, 71 Laurel St.
Reilly & Peyton, 1163 N. Third St.
Reliance Machine Works, 4617 Hedge St., Frankford.
Rich, J. & G., 120 N. Sixth St.
Ridings, Peter J., 1535 Fitzwater St.
Riehl, Henry & Son, 1,30 N. Orianna St.
Riehle Bros. Testing Machine Co., 19 N. Sixth St.
Roscoe & Bishop, 306 Master St.
Roth, Gottlieb, 602 Beach St.
Ruoff, William, 129 Green St.
Rutschmann Bros., 426 Berks St.
Ruwell, William F., & Co., 1044 S. Chadwick St.
Schaum & Uhlinger, N. Second St. and Glenwood Ave.
Schmidt, Anton, 253 S. American St.
Schmidt, Joseph, 1461 N. 28th St.
Schofield, William, Kram's Ave. nr. Silverwood St., Manayunk.
Schramm, H. G., 602 N. Second St.
Schutte, Louis L., & Co., N. 12th St. cor. Thompson St.
Schweinfurt, August, 315 N. 10th St.
SELLERS, WILLIAM, & CO., Inc., 1600 Hamilton St. (See page 59.)
Seyfert, Chas. H., 306 Master St.
Shaw, Thomas, 915 and 1035 Ridge Ave.
Shemp, J. C., & Co., 4835 Lancaster Ave.
Shimwell, Henry S., 217 S. 24th St.
Shober, John, 188 N. Broad St.
Simpson, William L., N. Fifth St. cor. Buttonwood St.
Skevington, Henry, & Co., 1610 N. Phillip St.
Smerhoosky, Joseph, 824 N. Third St.
Smith, Drum & Co., 2507 Coral St.
Smith, James, Woolen Machinery Co., 411 to 421 Race St.
Snediker & Carr, 143 N. Seventh St.
Solomon, Charles S., & Co., 1015 Sansom St.
Southwark Foundry and Machine Co., 430 Washington Ave.
Sprague, William, & Co., 639 Filbert St.
Steward & Romaine Mfg. Co., Ltd., 123 N. Sixth St.
Stokes & Parrish Elevator Co., 702 Bullitt Bldg.
Stokes, F. J., Machine Co., N. E. cor. 13th and Noble Sts.
Stone, John P., cor. Cumberland and 13th Sts.
Stoy, Anton, 835 Buttonwood St.
Sutch, Henry J., Lemonte St. nr. Ridge Ave., Roxbury.
Tetlow & Broadfield, 146 Norris St.
Thomas, Charles, 32 N. Seventh St.
Thomas, Ervin, 1114 Frankford Ave.
Thompson Bros., 112 Bread St.
Thompson, James, 4729 Umbria St., Manayunk.
Thompson & Campbell, 1030 Germantown Ave.
Thompson, J., & Co., Vanhorn & Sophia Sts.

MACHINISTS—Continued.

Thurston, Wilbur H., 708 Arch St.
Tilghman, B. C. & R. A., 1126 S. 11th St.
Toomey, H. C., & Co., 707 Lippincott Bldg.
Underwood, H. B., & Co., 1625 Hamilton St.
Union Machine Works, 418 Cherry St.
Valentine, Joseph, 148 N. Fourth St.
Vaughn Machine Co., 429 N. Orianna St.
Von Buchwald, William W., 120 N. Seventh St.
Walker Bros., & Co., 2227 Wood St.
Walker, Thos., & Sons, 4619 Tacony St., Frankford.
Walters, George C., 1316 Ellsworth St.
Walton, P. M., 1023 Germantown Ave.
Watson, Andrew, 2140 E. Firth St.
Weihe, Harry C., 2731 N. Phillip St.
Welch, Thomas, 148 N. Fourth St.
Weston, William H., & Co., 1303 Buttonwood St.
Whitecar, Joseph, 10 Pine St. and 402 S. Water St.
Widmer, Jacob, 1119 S. 18th St.
Wilbraham-Baker Blower Co., 2518 Frankford Ave.
Wilkes Mfg. Co., 243 Arch St.
Wilkinson, Walter, 3235 N. Front St.
Williamson Bros., Co., 2735 E. York St.
Wilson, Isaac J., 123 Spring St.
Withington, Ralph, 1638 N. Hutchinson St.
Wood, R. D., & Co., 400 Chestnut St.
Yates, John, 424 Vine St.
Zimemrman, Conrad, 407 Cherry St.

MACHINISTS' SUPPLIES.

Billany & Cochrane, 527 Commerce St.
Chicago Pneumatic Tool Co., 700 Fidelity Bldg.
CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 1718)
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
3176 Falkenan, Arthur, cor. 11th St. and Ridge Ave.
Harrington, Edwin, Son & Co., Inc., cor. Penna. Ave. & N. 15th St.
Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.
Johnson, Israel H., Jr., & Co., 1434 Callowhill St.
Kenyon, Frank C., 1840 Columbia Ave.
McFadden Co., 722 Arch St.
Pedrick & Ayer Co., 1001 Hamilton St.
Phila. Machinery & Supply Co., 19 N. Seventh St.
Powell & Maddock, 40 N. Sixth St.
1827 ROOTS, P. H. & F. M., CO., 109 Liberty St., New York. (See insert opp. page 33.)
SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)
Seyfert's, L. F., Sons, 437 N. Third St.
Smith, Jas., & Co., Inc., 411 Race St.
Williamson & Cassedy, 526 Market St.

* MAGNESIA AND ASBESTOS SECTIONAL COVERINGS.

See also Boiler and Pipe Covering.

3148 ASBESTOS MFG. CO., 426 Market St. (See page 31.)

MARINE BOILERS AND ENGINES.

See also Boiler Makers.

ALMY WATER TUBE BOILER CO., 178-184 Allens Ave., Providence, R. I.
(See page 86.)
4864D HEINE SAFETY BOILER CO., 658 Bourse Bldg. (See page 87.)

MARINE PUBLICATIONS.

MARINE ENGINEERING, World Bldg., New York. (See page 29.)

MECHANICAL BOOKS.

See also Books, Mechanical.

PHILADELPHIA BOOK CO., 15 S. Ninth St. (See page 36.)
POWER PUBLISHING CO., 145 World Bldg., New York. (See page 4.)

MECHANICAL ENGINEERS.

See also Engineers, Mechanical.

2007 Barr, Wm. M., 112 N. Broad St.
5396D DALLETT, W. P., 49 N. 7th St.
5264 FRICK, HORACE E., 421 Chestnut St. (See page 55.)
GIFFORD, C. H., & CO., 135 N. Third St.

MECHANICAL PAPERS.

POWER PUBLISHING CO., World Bldg., New York. (See insert opp. page 56.)

MECHANICAL STOKERS.

4004 COLUMBIA STOKER CO., THE, 1001 Chestnut St.
Davis Automatic Stoker Co., Bridgeport, Pa.
1827 SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)
6040 WILKINSON MFG. CO., Stephen Girard Bldg. (See page 81.)

Tripp Metallic Packing, for PISTON RODS and VALVE STEMS.

WM. B. MERRILL & CO., SOLE MANUFACTURERS,

Office and Factory, 297 Congress St., BOSTON, MASS.

* METAL, ANTI-FRICTION.

See also Babbitt Metal.

EASTWOOD WIRE MFG. CO., 120 Liberty St., New York. (See inside front cover.)

3176 **FAIRBANKS CO., THE, 701 Arch St.** (See front cover.)

METAL POLISH.

Bond, Casper, 2019 Moore St.
Byerly, N. H., 1232 S. 23d St.
Helmbold, Horace T., 446 N. 12th.
IMPERIAL POLISH CO., 123 S. Second St.
La Due, Thos. B., 1445 Westmoreland St.
Lohry & Johnson, 1252 N. 10th St.
Marks, Wm. T., 2110 Fairmount Ave.
Mullen, Wm. H., 2308 Oxford St.
Silver Suds Mfg. Co., 1225 Green St.
Smith, E. Everett, 49 N. 18th St.
Sommer, H. B., & Co., 628 Arch St.

METALLIC PACKING.

France, A. W., Tacony, Pa.
MERRILL, WM. B., & CO., "TRIPP," 297 Congress St., Boston, Mass. (See page 66.)
Ruwell, W. F., & Co., 17th St. and Washington Ave.
Underwood, H. B., & Co., 1025 Hamilton St.
U. S. Metallic Packing Co., 427 N. 18th St.
Walker, Thos., & Sons, 4619 Tacony, Frankford.
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-58.)

METAL WORKING MACHINERY.

1718 **CREGAR, J. W., Machinery Dept., Bourse Bldg.** (See insert opp. page 11.)

MICROMETER CALIPERS AND SMALL TOOLS.

1718 **CREGAR, J. W., Machinery Dept., Bourse Bldg.** (See insert opp. page 11.)

* MILL HOSE.

4747 **EUREKA FIRE HOSE CO., 14 N. Fourth St.** (See insert opp. page 33.)

MILLING MACHINES (UNIVERSAL, PLAIN AND VERTICAL).

1718 **CREGAR, J. W. (Machinery Dept.), Bourse Bldg.** (See insert opp. page 11.)

MILL SUPPLIES.

Allen, E., & Co., 5010 Lancaster Ave.
Bell, Harry E., 201 Church St.
Bergstresser, Samuel, 50 N. 23d St.
Bickerton, Thos. B., 23 N. Sixth St.
Billany & Cochrane, 527 Commerce St.
Bowen & Martin, 112 S. Second St.
BOYD, JAS., & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 **DANIEL, CHAS. A., 409 Market St.** (See insert opp. page 10.)
Etsweiler, Wm., 230 N. Third St.
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
Fawcett, Thos., 19 Strawberry St.
Furner, Chas., & Co., 15th St. cor. Fairmount Ave.
5040 GARLOCK PACKING CO., THE, 28 N. Fifth St. (See insert opp. page 11.)
General Equipment and Engineering Co., 8 S. Water St.
Glazier, Wm. H., 1302 Filbert St.
Hall, Wm. E., 1629 N. 10th St.
Halyburton, Chas., 217 Walnut St.
Hanna, Cyrus T., 441 Bourse Bldg.
Lonergan, John E., & Co., 211 Race St.
McComb, A. M., Mgr., 116 N. Third St.
Middleton, Howard W., Co., 945 Ridge Ave.
Mitchell-Bissell Co., 228 Arch St.

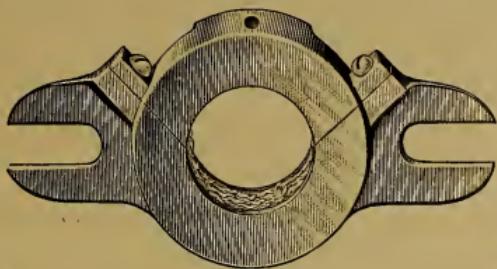
WALSH PACKING CO., 1118 and 1120 South Seventh Street, Philadelphia, manufacturers of Walsh Metal Face Packing, the best Hydraulic Packing in the market for Elevators, Direct Lifts, Accumulators, Water Ends of Pumps, Hot Water, Power and Belt Plunger Pumps. Walsh Combination Gaskets can be used from ten to thirty times.

ANDREWS' PISTON-ROD OILER.

Saves Packings,

Reduces Friction,

Keeps a Clean Rod.



Indispensable on

Locomotives and all

Engines Using

Metallic Packings.

MAKES A HANDSOME APPEARANCE.

—MADE BY—

THOMAS P. CONARD, 119 South 4th St., Philadelphia.

MILL SUPPLIES—Continued.

PEERLESS RUBBER MFG. CO., THE, 16 Warren St., N. Y. (See inserts opp. pages 68-69.)

Peirce, Edwin L., 245 Market St.

REILLY, JAS., REPAIR & SUPPLY CO., foot of Washington Ave.

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

Schlossman, Paul, 56 N. Sixth St.

Smith, James, & Co., Inc., 411-421 Race St.

Spaulding & Metcalf, 532 Arch St.

Vance, James M., & Co., 211-213 Market St.

Williamson & Cassidy, 526 Market St.

MINERAL WOOL.

ASBESTOS MFG. CO., 426 Market St. (See page 31.)

* MOTORS (COMPRESSED AIR).

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

* MOTORS (ELECTRIC).

See also Dynamos and Motors.

B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

KEYSTONE ELECTRIC CO., 129 S. 11th St.

* MOTORS (VOLUMETRIC).

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

OIL CUPS.

Binder, G., & Co., 443-445 N. 10th St.

EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

France, A. W., Tacony, Pa.

Lonergan, J. E., & Co., 211 Race St.

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)

REILLY, JAMES, REPAIR & SUPPLY CO., foot of Washington Ave.

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

* OIL CUPS (AUTOMATIC).

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

OILING DEVICES.

Bailey, F. E., & Co., 918 Betz Bldg.

EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

Lonergan, J. E., & Co., 211 Race St.

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)

REILLY, JAMES, REPAIR & SUPPLY CO., foot of Washington Ave.

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

OIL EXTRACTORS.

Brogan & Co., 810 Race St.

Keystone Engine and Machine Works, cor. Fifth and Buttonwood Sts.

HARRISON SAFETY BOILER WORKS, 17th St., bel. Allegheny Ave. (See pages 50-75.)

HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

STILWELL-BIERCE & SMITH VAILE CO., THE (P. B. Fenlon, Mgr.), 612 Arch St.

WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

OIL FILTERS.

Bailey, F. E., & Co., 918 Betz Bldg.
BURT MFG. CO., THE (Mfrs. of the "CROSS"), Akron, O.
 Houghton, E. F., & Co., "Acme," Third St., cor. Somerset St.
 Keystone Engine and Machine Works, cor. Fifth and Buttonwood Sts.
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
 Universal Oil Filter Co. (Ltd.), 367 Bourse Bldg.
 Weaver Filter Mfg. Co. (Ltd.), The, 532 Arch St.

OIL (GRAPHITE CYLINDER).

1531 **DIXON, JOSEPH, CRUCIBLE CO.**, 38 N. Fourth St. (See page 1.)

OIL (GRAPHITE MACHINE).

1531 **DIXON, JOSEPH, CRUCIBLE CO.**, 38 N. Fourth St. (See page 1.)

* OIL PUMPS.

4549 **PENNA. MACHINE CO.**, 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps.) (See page 73.)

OILS (LUBRICATING).

5094 Atlantic Refining Co., 125 Arch St.
BORNE-SCRYSMSEY CO., 223 N. Front St.
 Crew-Levick Co., 118 Arch St.
 Delaware Lubricating Oil Refining, 1214 Filbert St.
 Energetic Oil Co., 148 N. Second St.
 France, A. W., Tacony, Pa.
 Frick, Nathan, & Co., 262 N. Fourth St.
 Germania Oil & Supply Co., 114 N. Third St.
 Halyburton, C., Jr., 217 Walnut St.
 Haugh, John, & Co., 111 S. Water St.
 Helmbold, F. G., 210 Walnut St.
 Houghton, E. F., & Co., 244 Somerset St.
JENKINS, WARNER H., Penn Mutual Bldg.
LEONARD & ELLIS, 433 N. Third St.
 Loos & Dilworth, 38 N. Delaware St.
 Maddock, T. Edgar, 40 N. Sixth St.
NEW YORK LUBRICATING OIL CO., 319 Walnut St.
 Skipton, Valentine, Co., 2321 N. 30th St.
VACUUM OIL CO., 305 Walnut St.
 Walton, F. S., & Co., 184 S. Delaware Ave.
WARLEY, THOS. C. & CO., 11 S. Ninth St.
WILSON-CLARK CO., 107 S. Water St.
 Zurn, O. F., Co., 408 Vine St.

PACKING.

4747 **BARRETT & PLOWMAN, "REGAL,"** 1312 Filbert St.
BOSTON BELTING CO., 14 N. Fourth St. (See insert opp. page 57.)
BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
 Cancos Mfg. Co., 235 N. Front St. and 221 Chestnut St.
 Canfield Mfg. Co., Ltd., cor. Vine and Franklin Sts.
DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
EUREKA PACKING CO., 14 N. Fourth St. (See insert opp. page 33.)
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
 Glanding, James, Co., 1907-1909 N. Sixth St.
 Globe Packing Co., 113 Chestnut St.
 Halyburton, C., Jr., 217 Walnut St.
JENKINS BROS., "96," 117 N. Fourth St. (See inside front cover.)
JOHNS, H. W., MFG. CO., 170-172 N. Fourth St.
 Latta & Mulconroy, 1217 Market St.
MABBS HYDRAULIC PACKING CO., Box 829, Chicago, Ill. (See page 57.)
MERRILL, WM. B., & CO., 297 Congress St., Boston, Mass. (See page 66.)
 Montgomery Bros., 513 North St.
NEW JERSEY ASBESTOS CO., THE, "GLADIATOR," 117 N. Front St.,
 Camden, N. J. (See page 31.)
 New York Belting & Packing Co. (Ltd.), 308 Chestnut St.
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
QUAKER CITY RUBBER CO. (Daniels, P. P. P.), 409 Market St. (See insert opp. page 10.)
 Regal Packing Co. (Barrett & Plowman, Agts.), 1312 Filbert St.
 Restein, Clement, & Co., 15 N. Fourth St.
 Revere Rubber Co., 508 Drexel Bldg.
ROBERTSON, JAMES L., & SON, Betz Bldg. (See page 79.)
 St. John Cylinder Packing Co., 1025 Hamilton St.
 Smith, James, & Co., Inc., 411-421 Race St.
 Spaulding & Metcalf, 532 Arch St.
 Townsend, Isaac, 1217 Filbert St.
 Underwood, H. B., & Co., 1025 Hamilton St.
 United States Metallic Packing Co., 428 N. 13th St.
 Walker, Thos., & Sons, 4619 Tacony St., Frankford.
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)
 Watts, John M., Sons, 123 S. Second St.
 Williamson & Cassedy, 526 Market St.

THE "PEERLESS"

Spiral Piston and Valve Rod Packing

Once Tried,

Always Used.



Will Hold

400 Lbs.

Steam.

Expressly for High Speed Engines. 

 Twenty Years Old and No Equal.

1-4 to 2 inch diameter.

In boxes 3 to 8 lbs.

Manufactured Exclusively by

PEERLESS RUBBER MFG. CO.,

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CHICAGO, ILL

17-19 Beale Street and 18-24 Main Street, SAN FRANCISCO, CALIFORNIA.

RAINBOW PACKING

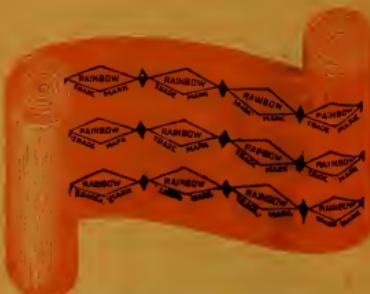
Makes a STEAM JOINT Instantly.

THE COLOR OF RAINBOW IS RED.

NOT AFFECTED BY OILS,
AMMONIA, LIQUORS,
STEAM HEAT OR ALKALIES

None genuine without
the Trade-Marks.

RAINBOW PACKING HAS 3
ROWS OF DIAMONDS IN
BLACK EXTENDING
THROUGHOUT
THE ENTIRE LENGTH OF
EACH AND EVERY ROLL.



Fac-simile of a Roll of Rainbow Packing.

Thousands of Imitators, No Equal.
Will Hold Highest Pressure.

Don't have to use wire and cloth to
hold Rainbow. Can't blow it out.

SEND FOR CATALOGUE.

PATENTED AND MANUFACTURED EXCLUSIVELY BY

PEERLESS RUBBER MFG. CO.

16 WARREN STREET, NEW YORK.

16-24 WOODWARD AVE.,
DETROIT, MICH.

202-210 SO. WATER ST.,
CHICAGO, ILL.

17-19 BEALE ST. AND 18-24 MAIN ST., SAN FRANCISCO, CAL.

Eclipse Sectional Rainbow Gasket.

3-8 inch for
Pipe Unions.
1-2 inch for
Hand Holes.

5-8 inch for
Regular Size.
3-4 inch for
Large Size.



Fac-simile of a 6-inch section of Eclipse Gasket, showing Name and Trade-Mark imbedded.

The ECLIPSE GASKET is red in color, and composed of the celebrated **Rainbow Packing Compound**. It will not harden under any degree of heat or blow out under the highest pressure, and can be taken out and repeatedly replaced. Joints can be made in from three to five minutes.

Patented and Manufactured Exclusively by

Peerless Rubber Mfg. Co.,

16 Warren Street, NEW YORK.

16-24 Woodward Avenue,

DETROIT, MICH.

202-210 So. Water Street,

CHICAGO, ILL.

17-19 Beale Street and 18-24 Main Street, SAN FRANCISCO, CAL.

HONEST JOHN

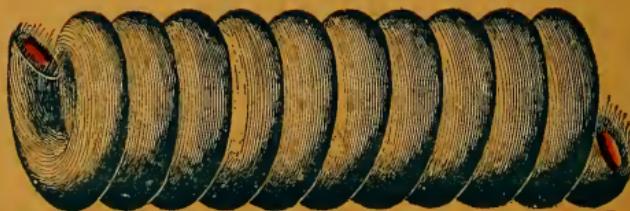


HYDRAULIC RAINBOW CORE PACKING.

We make this Packing both straight and in spiral form. The best Hydraulic and Cold Water Packing in the world.

TRADE

HERCULES COMBINATION



METALLIC STOP VALVE PACKING

M A R K.

This packing is, as yet, the only packing produced that will pack Stop and Throttle Valves so that they are perfectly reliable, and can be opened and closed with ease by hand, without using a heavy wrench.

Patented and Manufactured Exclusively by

The Peerless Rubber Mfg. Co.,

16 Warren St., NEW YORK.

16-24 Woodward Avenue,
DETROIT, MICH.

202-210 So. Water Street,
CHICAGO, ILL.

17-19 Beale Street and 18-24 Main Street,
SAN FRANCISCO, CAL.

* PACKING (AMMONIA).

See also Packing.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
5040 GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)

* PACKING (HYDRAULIC).

See also Packing.

4747 BARRETT & PLOWMAN, "REGAL," 1312 Filbert St.
765 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
3176 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
5040 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
MABBS HYDRAULIC PACKING CO., Box 829, Chicago, Ill. (See page 57.)
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)

* PACKING (METALLIC).

See also Packing and Metallic Packing.

MERRILL, WM. B., & CO., "TRIPP," 297 Congress St., Boston, Mass. (See page 66.)
United States Metallic Packing Co. 428 N. 13th St.
Walker, Thos., & Sons, 4619 Tacony, Frankford.
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)

* PACKING (PISTON AND VALVE ROD).

See also Packing.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
3176 GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
5040 PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

* PACKING (RUBBER).

See also Packing.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
3176 GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
5040 PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

* PACKING (SHEET).

See also Packing.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
3176 GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
5040 PEERLESS RUBBER MFG. CO., THE, "RAINBOW," 16 Warren St., New York. (See inserts opp. pages 68-69.)
Spaulding & Metcalf, "Rubberbestos," 532 Arch St.

* PACKING (STEAM).

See also Packing.

4747 BARRETT & PLOWMAN, "REGAL," 1312 Filbert St.
765 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
3176 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
5040 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
MERRILL, WM. B., & CO., "TRIPP," 297 Congress St., Boston, Mass. (See page 66.)

765 PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)
QUAKER CITY RUBBER CO., "DANIELS, P. P. P.", 409 Market St. (See insert opp. page 10.)
ROBERTSON, JAS. L., & SON, Betz Bldg. (See page 79.)
WALSH PACKING CO., 1118-1120 S. Seventh St. (See pages 57-66.)

* PACKING (VULCABESTON).

FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

* PACKING (WATER).

See also Packing.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
3176 GARLOCK PACKING CO., 28 N. Fifth St. (See insert opp. page 11.)
5040 PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

PAINT (GRAPHITE BOILER FRONT).

1531 DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)

PAINT (GRAPHITE SMOKE STACK).

1531 DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)

PAPER PULLEYS AND FRICTIONS.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

PHOSPHOR BRONZE.

6963 EYNON-EVANS MFG. CO., THE, 15th and Clearfield Sts. (See page 58.)

Parsons, B. T., 24 George St., Camden, N. J.

Phosphor Bronze Smelting Co., Ltd., 2200 Washington Ave.

PIPE AND BOILER COVERING.

See also Boiler and Pipe Covering.

3148 ASBESTOS MFG. CO., 426 Market St. (See page 31.)

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)

4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.

429 Camden } NEW JERSEY ASBESTOS CO., 117 N. Front St., Camden, N. J. (See page 31.)

PIPE BENDING AND COILS.

6870 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See pages 50-75.)

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

PIPE CLEANERS.

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

*** PIPE CUTTERS.**

ARMSTRONG MFG. CO., THE, Bridgeport, Conn. (See insert opp. page 33.)

PIPE THREADING AND CUTTING OFF MACHINES.

ARMSTRONG MFG. CO., THE, Bridgeport, Conn. (See insert opp. page 33.)

Cox & Sons Co., The, 215 Race St.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

CURTIS & CURTIS, 200 Garden St., Bridgeport, Conn. (See page 40.)

PIPE WRENCHES.

ARMSTRONG MFG. CO., THE, Bridgeport, Conn. (See insert opp. page 33.)

PLANERS, IRON AND WOOD WORKING.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

PLANIMETERS.

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

*** PNEUMATIC DRILLS.**

CLEMENT PNEUMATIC TOOL CO., 123 S. 11th St.

*** PNEUMATIC TOOLS AND APPLIANCES.**

CLEMENT PNEUMATIC TOOL CO., 123 S. 11th St.

PNEUMATIC TUBES.

Batcheller Pneumatic Tube Co., 916 Girard Bldg.

REILLY, JAS., REPAIR & SUPPLY CO., ft. of Washington Ave.

POLISHING MACHINERY.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

*** POLISH, METAL.**

See also Metal Polish.

IMPERIAL POLISH CO., 123 S. Second St.

*** POP SAFETY VALVES.**

See also Valves, Pop Safety.

ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

POWER TRANSMITTING MACHINERY.

4572 CRESSON, GEO. V., CO., cor. 18th St. and Allegheny Ave.

Link Belt Engineering Co., The, Hunting Park Ave., Nicetown.

SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)

Smith, Jas., & Co. Inc., 411 Race St.

PRESSES, POWER, FOOT AND DROP.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

PRESSURE AND DAMPER REGULATORS.

Brogan & Co., Kieleys, 810 Race St.

Chappell, Geo. H., 4365 Main St., Manayunk.

HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

LOCKE REGULATOR CO., Salem, Mass. (See page 39.)

5702 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

PULLEY COVERING.

Shultz Belting Co., 116 N. Third St.

PULLEYS.

See also Shafting, Hangers and Pulleys.

American Pulley Co., The, cor. 18th St. and Hamilton Ave.

Blanton Patents Syndicate, (Ltd.), 554 Bourse Bldg.

1509 Bond, Chas., 520 Arch St.

4572 CRESSON, GEO. V., CO., cor. 18th St. and Allegheny Ave.

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

Medart Patent Pulley Co., 1215 Stephen Girard Bldg.

Phila. Machinery & Supply Co., 19 N. Seventh St.

1827 SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)

Smith, Jas., Woolen Machinery Co., 41-421 Race St.

PULLEYS (WOOD SPLIT).

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

Medart Patent Pulley Co., Stephen Girard Bldg.

Phila. Machinery & Supply Co., 19 N. Seventh St.

PUMP PRESSURE REGULATORS.

HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

PUMP VALVES, RUBBER.

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.

PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

* PUMPING MACHINERY.

See also Pumps.

2007 DALLETT, W. P., "Deming and Buffalo Pumps," 49 N. Seventh St.

1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.

4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps.) (See page 73.)

4081 SNOW STEAM PUMP WORKS (Thos. C. McBride, Mgr.), 946 Drexel Bldg. (See page 73.)

* PUMPS (BELT).

See also Pumps.

2007 Buffalo Steam Pump Co., 49 N. Seventh St.

2007 DALLETT, W. P., "Buffalo and Deming Pumps," 49 N. Seventh St.

1514 Deming Co., 49 N. Seventh St.

4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps.) (See page 73.)

216 SCIPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St. Simpson, Wm. L., cor. Fifth and Buttonwood Sts.

* PUMPS (ELECTRIC).

2007 DALLETT, W. P., "Buffalo and Deming Pumps," 49 N. Seventh St.

1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.

4390 KEYSTONE ELECTRIC CO., 129 S. 11th St.

4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps.) (See page 73.)

216 SCIPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St.

4081 SNOW STEAM PUMP WORKS (Thos. C. McBride, Mgr.), 946 Drexel Bldg. (See page 73.)

2041 WORTHINGTON, HENRY R., 724 Arch St.

* PUMPS (POWER).

See also Pumps.

2007 DALLETT, W. P., "Deming and Buffalo Pumps," 49 N. Seventh St.

4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps.) (See page 73.)

1216 STILWELL-BIERCE & SMITH VAILE CO., THE (P. B. Fenlon, Mgr.), 612 Arch St.

PUMPS (ROTARY).

ROOTS, P. H. & F. M., CO., 109 Liberty St., New York. (See insert opp. page 32.)

PUMPS (STEAM).

Barr Pumping Engine Co., 18th St. and Leh'g Ave.
Berryman, James, 125 N. Fourth St.
Blatchley, Chas. G., Swanson St. cor. McKean St.
Buffalo Steam Pump Co., 49 N. Seventh St.
Burchfield, T. T., 55 N. Seventh St.
Crossland, Andrew, 4543 Worth St., Frankford.
2007 DALLETT, W. P., "Deming and Buffalo Pumps," 49 N. Seventh St.
Davies Bros. & Hartman, 18 N. Seventh St.
Davis Belt Feed Pumps, 125 N. Fourth St.
Deane Steam Pump Co., 18 N. Seventh St.
Deming Co., 49 N. Seventh St.
1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.
Dingas, John, 172 Ontario St.
Douglas, W. & B., 156 N. Fifth St.
216 GOULDS MFG. CO., 107 N. Third St.
Griffiths, Niedermayer & McGuckin, 1013 Christian St.
Hamscher, Henry, 23 Rising Sun Lane.
Howard, George C., Foundry and Machine Works, 1743 Ludlow St.
Kennedy, Geo. D., 1801 Gratz St.
Keystone Engine & Machine Works, cor. Fifth and Buttonwood Sts.
Laidlaw-Dunn-Gordon Co., 333 Bourse Building.
Mast, P. P., & Co., cor. Willow and 13th Sts.
4549 PENNA. MACHINE CO., 29-31 N. Seventh St. (The John H. McGowan Co.'s Pumps.) (See page 78.)
Rich, J. & G., 120 N. Sixth St.
Rider-Ericsson Engine Co., 31 N. Seventh St.
Ristine, Geo., 1044 Frankford Ave.
Robertson, Geo. W., & Son, 156 N. Fifth St.
Scales, Samuel, 905 N. 47th St.
Schlichter, E. F., 321 Vine St.
216 SCIPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St.
Seyfert s, L. F., Sons, 427 N. Third St.
Simpson, Wm. L., Fifth and Buttonwood Sts.
4081 1216 2041 SNOW STEAM PUMP WORKS (Thos. C. McBride, Mgr.), 946 Drexel Bldg. (See page 73.)
STILWELL-BIERCE & SMITH VAILE CO., THE (P. B. Fenlon, Mgr.), 612 Arch St.
WORTHINGTON, HENRY R., 724 Arch St.

* PUMPS (VACUUM).

2007 DALLETT, W. P., "Deming and Buffalo Pumps," 49 N. Seventh St.

PYROMETERS.

Brown, Edward, 311 Walnut St.
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

RADIATORS.

American Radiator Co., 506 Arch St.
Fowler & Wolfe Mfg. Co., 664 Bourse Bldg.
4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
Pancoast, Henry B. & Co., 243 S. Third St.
Phila. Hardware & Malleable Iron Works, cor. Ninth and Jefferson Sts.
1527 SMITH, H. B., CO., THE, 510 Arch St. (See page 77.)
Standard Radiator Mfg. Co., 27 N. Seventh St.
TITUSVILLE IRON CO. (B. N. Hurd, Mgr.), Bourse Bldg.

RADIATOR VALVES.

See also Valves.

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
1514 DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.

RAILROAD SUPPLIES.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)

REDUCING VALVES.

EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)
5702 HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

REDUCING WHEELS.

ROBERTSON MFG. CO., Betz Bldg. (See page 79.)

REFRIGERATING MACHINES.

See also Ice-Making Machinery.

De La Vergne Refrigerating Machine Co., Girard Bldg.
NEWBURGH ICE MACHINE & ENGINE CO., 1326 Chestnut St.

REGRINDING VALVES.

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

REGULATORS (DAMPER).

See also Damper Regulators.

LOCKE REGULATOR CO., Salem, Mass. (See page 29.)



SNOW

THE SNOW STEAM PUMP WORKS

BUFFALO, N. Y., U. S. A.

Pumping Machinery of Every Description.

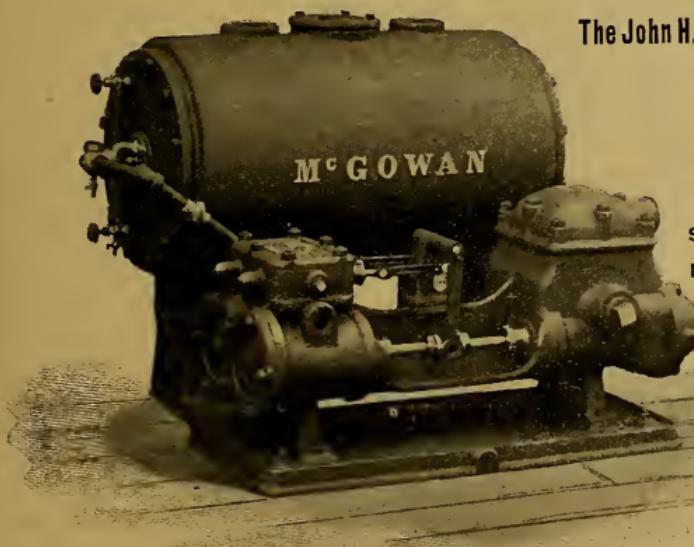
NEW YORK OFFICE, 126 Liberty Street.

BOSTON OFFICE, 35 Congress Street.

PHILADELPHIA OFFICE, 946 Drexel Building.

Pennsylvania Machine Co.,

31 North Seventh Street, PHILADELPHIA, Pa.



The John H. McGOWAN Company's
PUMPING
MACHINERY

SINGLE CYLINDER,
DUPLEX AND CRANK
AND
FLY WHEEL
PUMPS
FOR
GREATEST
VARIETY
OF
SERVICE.

Compound Single Cylinder and Duplex Pumping Engines.

* REGULATORS (PRESSURE).

5702 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

REGULATORS (STEAM, WATER AND AIR).

Brogan & Co., "Kieley's," 810 Race St.
Chappell, Geo. H., 4365 Main St., Manayunk.

5702 LOCKE REGULATOR CO., Salem, Mass. (See page 39.)
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

* RETURN STEAM TRAPS.

Sé also Steam Traps.

6870 HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-75.)

ROLLING MILL MACHINERY.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

ROOF PAINT (GRAPHITE).

1531 DIXON, JOSEPH, CRUCIBLE CO., 38 N. Fourth St. (See page 1.)

* ROPE TRANSMISSION.

PENNA. IRON WORKS CO., cor. 50th St. and Lancaster Ave.

RUBBER BELTING.

Sé also Belting.

4747 BOSTON BELTING CO., 14 N. Fourth St. (See insert opp. page 57.)
4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)
PEERLESS RUBBER MFG. CO. (THE), 16 Warren St., New York. (See inserts opp. pages 68-69.)

RUBBER GOODS (MECHANICAL).

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)

Etsweiler, Wm., 230 N. Third St.
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)
5040 GARLOCK PACKING CO., THE, 28 N. Fifth St. (See insert opp. page 11.)

Goldberger, Wm., 1118 Germantown Ave.

Goodyear Rubber Belting and Packing Co., 308 Chestnut St.

Goodyear Rubber Hose and Packing Co., 221 Chestnut St.

Keating Rubber Co., 509 North St.

Latta & Mulconroy, 1217 Market St.

Levick's, R., Son, & Co., 720 and 1230 Chestnut St.

McCambridge Rubber Co., 1237 Filbert St.

Manhattan Rubber Mfg. Co. 1217 Market St.

Montgomery Bros., 48 N. Front St.

New York Belting and Packing Co., Ltd., 308 Chestnut St.

Nice, H. N., & Bro., 1215 Filbert St.

PEERLESS RUBBER MFG. CO. (THE), 16 Warren St., New York. (See inserts opp. pages 68-69.)

Peirce, Edwin L., 245 Market St.

Penn Rubber Co., 608 Arch St.

Phila. & Bolivia Rubber Co., 470 Bourse Bldg.

Phila. Rubber Co., 608 Arch St.

765 PHILA. RUBBER WORKS, 2417 South St.

QUAKER CITY RUBBER CO., 409 Market St. (See page 10.)

Restein, Clement & Co., 15 N. Fourth St.

Revere Rubber Co., 508 Drexel Bldg.

Rhoads, J. E., & Sons, 239 Market St.

Sayen & Austin Rubber Co., 21 N. 13th St.

Snyder, M. L., 25 S. Second St.

Spaulding & Metcalf, 532 Arch St.

Stevenson Bros., & Co., 132 S. Second St.

Tillinghast, B. C., 39 S. Second St.

Town & Bro., 607 Market St.

U. S. Rubber Co., 407 Commerce St.

* RUBBER HOSE.

Sé also Hose.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)

765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)

4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 33.)

PEERLESS RUBBER MFG. CO. (THE), 16 Warren St., New York. (See inserts opp. pages 68-69.)

765 QUAKER CITY RUBBER CO., 409 Market St. (See insert opp. page 10.)

Our statements (because based on facts) impressed the head of a certain firm—he needed an Oil Separator—ordered a COCHRANE. When our bill reached him, he marked it "ON APPROVAL" and sent it down to his engineer; and when that bill with check came back to our office it bore, beneath the words "On Approval," the engineer's comment:

"WORKS ALL RIGHT"

These words tell the whole story about the Cochrane Separators. They come up to the expectations of their users—for taking oil out of exhaust steam, water out of live steam, water out of compressed air, etc. Our catalogue lists 105 different forms and sizes.

HARRISON SAFETY BOILER WORKS, Philadelphia, Pa.

* RUBBER PACKING.

See also Packing.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
 765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
 5040 GARLOCK PACKING CO., THE, 28 N. Fifth St. (See insert opp. page 11.)
 PEERLESS RUBBER MFG. CO., THE, 16 Warren St., N. Y. (See inserts opp. pages 68-69.)

* SAFETY VALVES (POP).

See also Valves, Pop Safety.

ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.
 CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
 LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)
 SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

* SAFETY VALVES (RENEWABLE).

FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

SAFETY WATER COLUMNS.

4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
 RELIANCE GAUGE CO., THE (P. B. Huyette, Sales Agent), 1213 Betz Bldg.
 (See page 2.)

* SCREW MACHINES.

1718 CREGAR, J. W., Machinery Department, Bourse Bldg. (See insert opp. page 11.)

SEPARATORS (OIL).

4585 Brogan & Co., 810 Race St.
 6870 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See pages 50-75.)
 702 ROBERTSON MFG. CO., Betz Building. (See page 79.)
 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

SEPARATORS (STEAM).

Austin Separator Co., 1215 Filbert St.
 Brogan & Co. (Kieley's), 810 Race St.
 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See pages 50-75.)
 HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
 Kensington Engine and Machine Works, Fifth and Buttonwood Sts.
 ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
 Simpson, Wm. L., Fifth and Buttonwood Sts.
 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)
 Webster, Warren & Co., Stephen Girard Bldg.

SHAFTING, HANGERS AND PULLEYS.

Bethlehem Iron Co., 421 Chestnut St.
 Blanton Patents Syndicate, Ltd., 554 Bourse Bldg.
 Bond, Chas., 520 Arch St. and 160 Lehigh Ave.
 Chambers Bros. Co., 52d St. nr. Lancaster Ave.
 6805 CRESSON, GEO. V., CO., cor. 18th St. and Allegheny Ave.
 Cumberland Iron and Steel Shafting Co., 520 Arch St.
 3176 FAIRBANKS CO. (THE), 701 Arch St. (See front cover.)
 Fairmount Machine Co., 2106 Wood St.
 Garvin Machine Co., 51 N. Seventh St.
 Grant Gear Works, 624 Race St.
 Henning, John, & Son, 1018 E. Susquehanna Ave.
 Hodson, G. & J., 226 Arch St.
 Howard, Geo. C., Foundry & Machine Works, 1743 Ludlow St.
 Link Belt Engineering Co. The, Hunting Park Ave., Nicetown.
 Mitchell Bissell Co., 228 Arch St.

SHAFTING, HANGERS AND PULLEYS—Continued.

Rich, J. & G., 120 N. Sixth St.
ROOTS, P. H. & F. M., CO., 109 Liberty St., New York. (See insert opp. page 32.)
1827 SELLERS, WM., & CO., Inc., 1600 Hamilton St. (See page 59.)
Seyfert's, L. F., Sons, 437 N. Third St.
Smith, Jas., Woolen Machinery Co., 411-421 Race St.
Thompson Bros., 112 Bread St.
Yocom, James, & Son, 145 N. Second St.

SHAFTS, FLEXIBLE.

UNION BOILER TUBE CLEANER CO., (FORSYTH), Pittsburgh, Pa. (See inserts opp. pages 82-83.)

SHAPERS, CRANK AND FRICTION.

1718 CREGAR, J. W., Machinery Department, Bourse Bldg. (See insert opp. page 11.)

SHEET IRON WORK.

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

Bailey, John, 510 S. Delaware Ave.
Bingham & Co., 232 Cherry St.
Coatesville Boiler Works, 112 N. Broad St.
Fox, Joseph W., 1416 Federal St.
Hibbs, E. A., cor. Bread and Quarry Sts.
McKnight, John, 4081 Lancaster Ave.
Nace, Henry J., 308 N. Third St.

1745 REILLY, JAMES, REPAIR & SUPPLY CO., ft. of Washington Ave.

Schaefer, Emil, 1830-1832 N. Fifth St.
Schnitzler, Chas H., 215 N. Second St.
Thorn, J. S., Co., 1227 Callowhill St.
Wentworth, L. E., & Son., 205 Quarry St.
Williams, J. T., 734 S. Fifth St.

* SMOKE CONSUMERS.

See also Furnaces, Smokeless.

4004 COLUMBIA STOKER CO., 1001 Chestnut St.
6040 WILKINSON MFG. CO., Stephen Girard Bldg. (See page 81.)

SMOKE STACKS.

See also Boiler Makers.

5409 AMES IRON WORKS, 511 Fidelity Bldg.
ATLAS ENGINE WORKS, 143 N. Third St. (See page 45.)

4864D HEINE SAFETY BOILER CO., 658 Bourse Bldg. (See page 87.)
1781 PHILA. ENGINEERING WORKS, Ltd., cor. Meadow and Mifflin Sts
STIRLING CO., THE, 205 Betz Bldg. (See page 87.)
Warden Mfg. Co., cor. 19th St. and Allegheny Ave.
York Mfg. Co., 476 Bourse Bldg.

* STACKS, (STEEL SELF-SUPPORTING).

5396D FRICK, HORACE E., 421 Chestnut St. (See page 55.)
STIRLING CO., THE, 205 Betz Bldg. (See page 87.)

1781 PHILA. ENGINEERING WORKS, Ltd., cor. Meadow and Mifflin Sts.

STEAM BLOWERS.

McCLAVE, BROOKS, & CO., 466 Bourse Bldg. (See page 54.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
STEWART HEATER CO., 51 Norfolk Ave., Buffalo, N. Y. (See page 49.)

STEAM BOILERS.

See also Boiler Makers and Dealers.

ALMY WATER TUBE BOILER CO., 178-184 Allens Ave., Providence, R. I.
(See page 86.)

5409 ATLAS ENGINE WORKS, 145 N. Third St. (See page 45.)
6870 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See
pages 50-75.)

4864D HEINE SAFETY BOILER CO., 658 Bourse Bldg. (See page 87.)
STIRLING CO., THE, 205 Betz Building. (See page 87.)

* STEAM ENGINES.

See also Engine Builders.

4549 ALLFREE, J. B., MFG. CO. (Penna. Machine Co., Agents), 31 N. Seventh St.
5409 ATLAS ENGINE WORKS, 143 N. Third St. (See page 45.)
5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
4549 CHANDLER & TAYLOR CO. (Penna. Machine Co., Agents), 31 N. Seventh St. (See
page 88.)

4549 NEWBURGH ICE MACHINE & ENGINE CO., 1326 Chestnut St.
PENNA. MACHINE CO., 31 N. Seventh St. (See page 88.)

STEAM FITTERS' SUPPLIES.

ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)
Belfield, H., & Co., 435 N. Broad St.

Brogan & Co., 810 Race St.

CRANE CO., 220-222 S. Fifth St. (See page 79.)

FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
Ford & Kendig Co., 27 N. Seventh St. and 1420 Callowhill St.

Getze & Bro., 507 Arch St.

GRIFFING, A. A. IRON CO., "BUNDY," 702 Arch St.

Haiues, W. S., Co., 136 S. Fourth St.

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)
McCambridge & Co., Ltd., 523 Cherry St.

Maneely, John, 309-313 Arch St.

Pancoast, Henry B., & Co., 243 S. Third St.

REILLY, JAMES, REPAIR & SUPPLY CO., ft. of Washington Ave.

* STEAM FLUE CLEANERS.

See also Tube Cleaners.

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

STEAM GAUGES.

ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.

Brown, Edward, 311 Walnut St.

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

RELIANCE GAUGE CO., THE (P. B. Huyette, Sales Agt.), 1213 Betz Bldg. (See page 2.)

Shaw, Thomas, 915 Ridge Ave.

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

Shipley, Walter C., 24 S. Seventh St.

STEAM HEATING APPARATUS.

American District Steam Co., 535 Drexel Bldg.

American Boiler Co., 28 N. Fifth St.

American Radiator Co., 506 Arch St.

B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

Baker, Smith & Co., 520 Commerce St.

Beckfield, Walter, Heater Co., Philadelphia Bourse.

Belfield, H., & Co., 435 N. Broad St.

Bourse Exhibition, S. Fourth and S. Fifth Sts. bet. Chestnut and Market Sts.

Bowers, Frank, 413 Philadelphia Bank Bldg.

Burchfield & Fenton, 55 N. Seventh St.

Conderman, Geo. W., 123 N. Sixth St.

Day, D. Franklin, Rorer St. near Abington Ave., Chestnut Hill.

Fowler & Wolfe Mfg. Co., 664 Philadelphia Bourse.

Francis Bros. & Jellett, Inc., 704 Arch St.

Gabel Mfg. Co., 922 Arch St.

Geiger, August, 118 N. Sixth St.

Germantown Steam Co., 505 Pelham Rd., Germantown.

GRIFFING, A. A. IRON CO., "BUNDY," 702 Arch St.

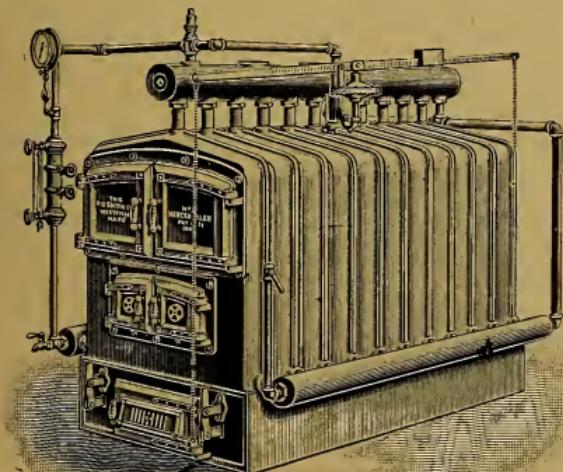
Guarantee Steam Heating Co., 213 S. Fifth St.

Haines, W. S., Co., 136 S. Fourth St.

Hanna & Kirk, 1028 Arch St.

HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-75.)

"THE MERCER"



THE H. B. SMITH CO.,

MANUFACTURERS,

510 Arch Street, - PHILADELPHIA.

THE MERCER BOILER AND HOT WATER HEATER.

The "COTTAGE" for Modern Homes.

Effective, Compact, Easily Managed.

THE MILLS SAFETY BOILER (Columbian Medal)

RADIATORS.

ROYAL. IMPERIAL. SOVEREIGN.

STEAM HEATING APPARATUS—Continued.

Heat Regulator & Plumbing Co., 1741 Ludlow St.
Herendeen Mfg. Co., The, 1019 Betz Bldg.
Hoppes Mfg. Co., 605 Girard Bldg.
Howard, Geo. C., Foundry and Machine Works, 1743 Ludlow St.
Innes Bros., 461 E. Girard Ave.
Keystone Heater Co., 2433 N. Sixth St.
Maneely, John, 309-313 Arch St.
Model Heating Co., American St. cor. Dauphin St. and 303 Builders' Exchange.
Monitor Steam Generator Mfg. Co., 49 N. Seventh St.
Mott, J. L., Iron Works, Builders' Exchange.
Murphy, Harry F., & Co., 25 N. Seventh St.
Myers & Co., 1520 S. Ninth St.
Nesbitt, John J., & Co., 805 Master St.
New York Central Iron Works Co., 428 Bourse Bldg.
Page, Wm. H., Boiler Co., 636 Arch St.
Pancoast, Henry B., & Co., 243-245 S. Third St.
Parish, Richard, 1516 Snyder Ave.
Phila. Hardware and Malleable Iron Works, cor. Ninth and Jefferson Sts.
Phila. Steam Heating Co., 1513 Elbert St.
Reeves & West, 645 Bourse Bldg.
Robinson, W. J., 641 Philadelphia Bourse.
Scott, Robert, & Co., 607 Arch St.
Smead & Willis, Warming & Ventilating Co., 417 Locust St.
SMITH, H. B., CO., THE, 510 Arch St. (See page 77.)
Smith, John P., 148 N. Seventh St.
Steel, George P., Co., 330 Philadelphia Bourse.
Stone, George F., & Co., 41 N. Seventh St.
Thompson Bros., 112 Bread St.
TITUSVILLE IRON CO. (B. N. Hurd, Mgr.), Bourse Bldg.
Trachsle, John C. F., 230 Arch St.
Tubular Heating & Ventilating Co., Inc., 228 Quarry St.
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)
Wahl, Chas., 2206 Ridge Ave.
Webster, Warren, & Co., 1106 Stephen Girard Bldg.
West, Charles F., 645 Philadelphia Bourse.
Wilson & Keyser, 1701 N. 11th St.
Wood, James P., Heating Co., 39 S. Fourth St.

STEAM HOSE.

See also Hose.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)
4747 EUREKA FIRE HOSE CO., 14 N. Fourth St. (See insert opp. page 23.)
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. page 68-69.)
765 QUAKER CITY RUBBER CO., 409 Market St. (See insert opp. page 10.)

STEAM PIPE AND BOILER COVERING.

See also Boiler and Pipe Covering.

3148 ASBESTOS MFG. CO., 426 Market St. (See page 31.)
1633 JOHNS, H. W., MFG. CO., 170-172 N. Fourth St.
429 Camden NEW JERSEY ASBESTOS CO., 117 N. Front St., Camden, N. J. (See page 31.)

STEAM PIPE AND FITTINGS.

See also Steam Fitters' Supplies.

1760 ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)
3176 CRANE CO., 220-222 S. Fifth St. (See page 79.)
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
Getze & Bro., 507 Arch St.
1745 LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)
REILLY, JAMES, REPAIR & SUPPLY CO., ft. of Washington Ave.

STEAM PRESSURE REGULATORS.

Brogan & Co., "Kieleys," 810 Race St.
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
LOCKE REGULATOR CO., Salem, Mass. (See page 39.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
5702 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

* STEAM PUMP GOVERNORS.

Brogan & Co., "Kieleys," 810 Race St.

STEAM PUMPS.

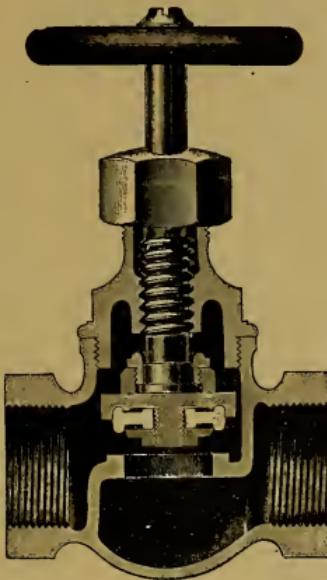
See also Pumps, Steam

2007 DALLETT, W. P., "Deming and Buffalo Pumps," 49 N. Seventh St.
1514 DILKS, FRANK W., & CO., "BLAKE," 518 Arch St.
216 SCIPPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St.
4081 SNOW STEAM PUMP WORKS (Thos. C. McBride, Mgr.), 946 Drexel Bldg. (See page 78.)
1216 STILWELL-BIERCE & SMITH-VAILE CO., THE (P. B. Fenlon, Mgr.), 612 Arch St.
2041 WORTHINGTON, HENRY R., 724 Arch St.

CRANE'S COPPER DISC VALVE

WITH RENEWABLE DISC.

A
PERFECT VALVE
AND A
PERFECT VALVE
DISC.



The Disc in this valve is made of soft copper turned up true in a lathe. Copper is a metal soft enough to make a good joint and hard enough to wear well. It also contracts and expands equally with body of valve—the joint is perfect hot or cold.

CRANE CO.,

220-222 South Fifth St.,
PHILADELPHIA, PA.

STEAM SEPARATORS.

See also Separators, Steam.

4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
6870 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See
pages 50-75.)
5702 HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

STEAM SPECIALTIES.

1760 CRANE CO., 220-222 S. Fifth St. (See page 79.)
6963 EVNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
4585 GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
Lonergan, J. E., & Co., 211 Race St.
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back
cover.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
5702 SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

Our Philadelphia Office, At 1213 Betz Building,

WILL BE IN CHARGE OF **Mr. WM. ROBERTSON.**

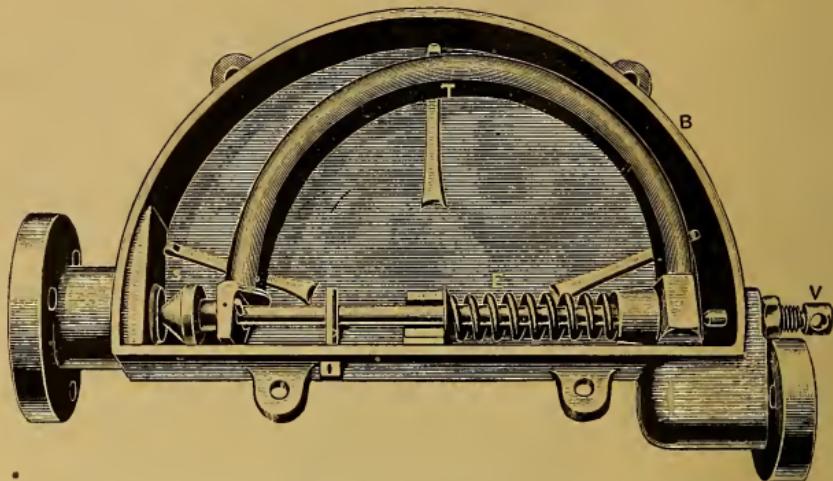
JAS. L. ROBERTSON & SON, New York.

ENGINE INDICATORS
OIL EXTRACTORS
DAMPER REGULATORS
PLANIMETERS
SQUARE FLAX PACKING

STEAM SEPARATORS
HINE ELIMINATORS
SHAKING GRATE BARS
FEED WATER HEATERS
STEAM FLUE CLEANERS

EUREKA PACKING
WASTE OIL FILTERS
REDUCING WHEELS
EXHAUST HEADS
SEMI-METALLIC PACKING

SIRIUS STEAM TRAP.



ADOPTED BY THE LEADING STEAM USERS THROUGHOUT THE WORLD.

SELLING AGENTS:

E. F. HOUGHTON & CO., Philadelphia, Pa.

H. B. SCHMIDT & CO., 215 E. 4th St., Cincinnati, O.

STEAM TRAPS.

5264 Brogan & Co., "Kieley's," 810 Race St.

6963 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)

3176 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

4585 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

GRIFFING, A. A., IRON CO., "BUNDY," 702 Arch St.

Haines, W. S., Co., 136 S. Fourth St.

7374 HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

SCHMIDT, H. B., & CO. (E. F. Houghton & Co., Agts.), 244 W. Somerset St. (See

page 80.)

Schutte, L., & Co., 12th and Thompson Sts.

* STEAM VALVES.

See also Valves.

ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

3176 DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.

826 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

JENKINS BROS., 117 N. Fourth St. (See inside front cover.)

LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

STOCKS AND DIES.

3176 ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)

CURTIS & CURTIS, 200 Garden St., Bridgeport, Conn. (See page 40.)

FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

STOKERS (AUTOMATIC).

4004 COLUMBIA STOKER CO., THE, 1001 Chestnut St.

6040 WILKINSON MFG. CO., Stephen Girard Bldg. (See page 81.)

SUCTION TEES AND FITTINGS.

HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

SWITCHBOARDS.

France, A. W., Tacony, Pa.

Pringle, Wm. T., & Co., 1028 Filbert St.

Sawyer Electrical Co., 1308 Arch St.

SYPHONS (BRASS AND IRON).

6963

EYNON-EVANS MFG. CO., THE, 15th and Clearfield Sts. (See page 58.)

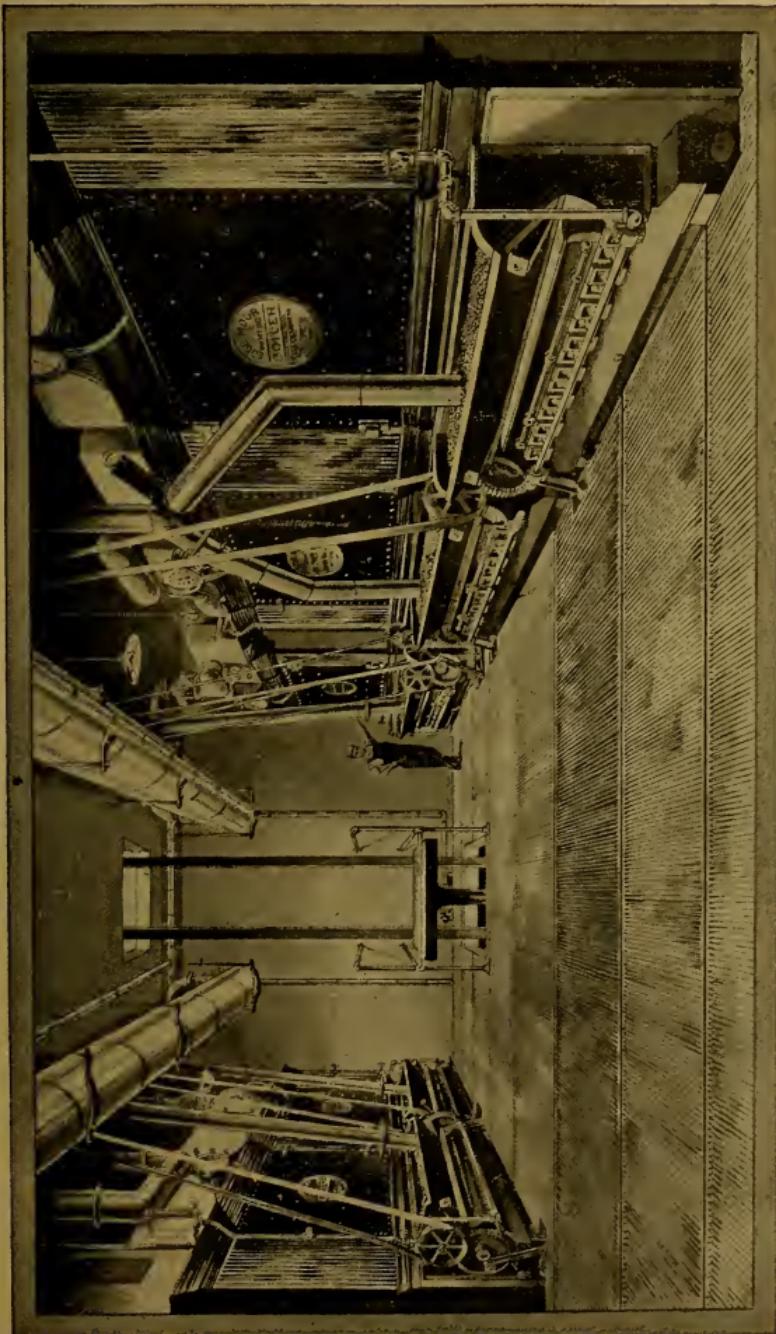
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

Wilkinson Manufacturing Co., Inc.

1107-8 Stephen Girard Bldg., Philadelphia, Pa.

ENGINEERS & CONTRACTORS

SEND FOR CATALOGUE A.



1,000 H. P. Water Tube Boilers, equipped with Wilkinson Automatic Stoker, at Stephen Girard Building, Philadelphia. OF GIRARD ESTATE.
Another Installation, Girard College, Philadelphia.
2,100 Stokers in successful operation under all conditions.

TANKS (IRON AND STEEL).

Baizley, John, 510 S. Delaware Ave.
Coatesville Boiler Works, Inc., 701 Fidelity Bldg.
FRICK, HORACE E., 421 Chestnut St. (See page 55.)
HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-75.)
HEINE SAFETY BOILER CO., 658 Bourse Bldg. (See page 87.)
Hibbs, E. A., cor. Quarry and Bread Sts.
PHILA. ENGINEERING WORKS, Ltd., cor. Mifflin and Meadow Sts.
PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)
SCIPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St.
STIRLING CO., THE, 205 Betz Bldg. (See page 87.)
Warden Mfg. Co., cor. 14th St. and Allegheny Ave.
York Mfg. Co., Bourse Bldg.

TELEPHONE SUPPLIES.

Bright, Evan D., 119 N. Sixth St.
Kelly, John E., 411 Cherry St.
Stadelman, Herman R., 313 Franklin Bldg.
Standard Telephone Mfg. Co., 401 S. Juniper St.

TOOL GRINDERS.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

TOOL MANUFACTURERS AND DEALERS.

Albright, John S., 510 Montgomery Ave.
American Tool Works Co., 19 N. Seventh St.
ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 23.)
Bagshaw & Field, r. 220 N. Second St.
Bechtel, Henry, & Co., 328 Vine St.
Bell, Frederick, S. 30th St. near Spruce St.
Bement, Miles & Co., 2001 Callowhill St.
Billany & Cochrane, 527 Commerce St.
Bonney Vise and Tool Works, 3015 Chestnut St.
Bourse Exhibition, S. Fourth and S. Fifth Sts. bet. Chestnut and Market Sts.
Brown & Sharpe Mfg. Co., Philadelphia Bourse.
Chicago Pneumatic Tool Co., 700 Fidelity Building.
Craddock, James, 2166 Rainbow St.
1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)
Crossley, Charles, 1411 Melon St.
Disston, Henry, & Sons, Inc., Tacony and N. Front Sts. cor. Laurel St.
Geiger, George, 308 Wood St.
Germantown Tool Works, 518 Commerce St. and 57 Armat St., Germantown.
Gleason, E. & F., Susquehanna Ave. cor. American St.
Haeseler, C. H., Co., 1035 Ridge Ave.
Hammond, C., & Son, 523 Philadelphia Bourse.
Hankey, A., & Co., 2235 Vine St.
Harrington, Edwin, Son & Co., Inc., N. 15th St. cor. Pennsylvania Ave.
Hendey Machine Co., Philadelphia Bourse.
Hildebrandt, A., 10 N. Seventh St.
Hood, Robert H., 1426 Callowhill St.
Hunt, Matthew W., 2329 Ridge Ave.
Johnson, Israel H., Jr., & Co., 1434 Callowhill St.
Lane, Joseph, 223 S. 24th St.
McVeigh & Mellow, 1614 N. Fifth St.
Milton, Job G., S. 30th St. cor. Locust St.
Newton Machine Tool Works, 2337 Vine St.
Niles Tool Works Co., 478 Philadelphia Bourse.
Parmalee, Homer, 130 Reed St.
Phila. Machinery & Supply Co., 19 N. Seventh St.
Plumb, Fayette R., Inc., Tucker St. cor. James St., Frankford.
Powell & Maddock, 40 N. Sixth St.
Pugh, Job T., 3101 Ludlow St.
Reif, George, 2848 Fairhill St.
SELLERS, WM. & CO., INC., 1600 Hamilton St. (See page 59.)
Starrett Co., L. S., The, Bourse Building.
Steffen, Gustav, 1607 N. Second St.
Stortz, John, & Son, 210 Vine St.
Stubbs Steel Co., 17 N. Fifth St.
T. & B. Tool Co., 622 Arch St.
Vare, John A., 236 N. Fourth St.
Veit, John, 135 Green St.
Yerger, David B., 208 S. Franklin St.

* TRAPS (STEAM).

See also Steam Traps

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
6870 HARRISON SAFETY BOILER WORKS, 17th St. bet. Allegheny Ave. (See pages 50-75.)
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
7374 SCHMIDT, H. B., & CO. (E. F. Houghton & Co., Agts.), 244 W. Somerset St. (See page 80.)

TRUCKS AND BARROWS.

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

WE WILL CONTRACT TO KEEP YOUR BOILERS CLEAN FOR SEVENTY-FIVE PER CENT. OF THE SAVING IN FUEL, TO BE DETERMINED BY A TEST OF YOUR BOILERS BEFORE AND AFTER CLEANING, OR WE WILL SELL OR LEASE OUR DEVICE, OR WILL CLEAN YOUR BOILERS BY CONTRACT AT A FIXED PRICE PER TUBE.

Those who have adopted our devices had exhausted chemistry, filtration, condensation, compounds, purifiers, scrapers and other alleged cleaners, and all other schemes that ingenuity could devise; they employed the best talent obtainable; all and everything resulted in absolute failure. How then can you hope to succeed? The adoption of our method results in instantaneous and interminable saving of from 25 per cent. to 50 per cent. of your fuel account; or a corresponding increase in the efficiency of your boilers where you use waste gases; so why hesitate? Profit by the experience of others; some of them certainly are your competitors.

Give us *the make, number of boilers, and number of tubes in each*, and we will make you such a proposition that you will see your way clear to adopt some one of our various devices. Please give all these particulars at first—it saves much time and correspondence.

We will take our No. 1 or No. 2 machine (as shown on the next two pages) to your plant and clean a boiler; if you are not perfectly satisfied, both as regards the time taken and the thoroughness with which the work is done, or if you conclude to purchase or lease the device, there will be no charge for this work; if the work is perfectly satisfactory, our charge will be \$1.00 per tube, at which rate we will clean your entire plant; after which our Impulse Cleaner should be adopted.

We make special devices for removing the sediment or incrustation from pipes or tubes, used in industrial enterprises, from 1 inch in diameter up to any size required.

All of our devices are guaranteed to do the work more rapidly, more thoroughly, and at less expense than any other device in the market, and without the possibility of injury to the tubes, however old or thin.

Descriptive circulars, with list of those who have adopted devices up to date, and copies of tests made by purchasers, showing the increased efficiency of boilers after our cleaning over the best they were able to accomplish, with testimonials showing the condition of boilers after thirty months' use, will be sent on application.

The burnishing of the interiors of tubes of new boilers, even before they are put in commission, is a feature now being seriously considered, with the almost certain result of being adopted by one of the largest and most successful of our boiler manufacturers; also by the manager of one of our largest rolling mills.

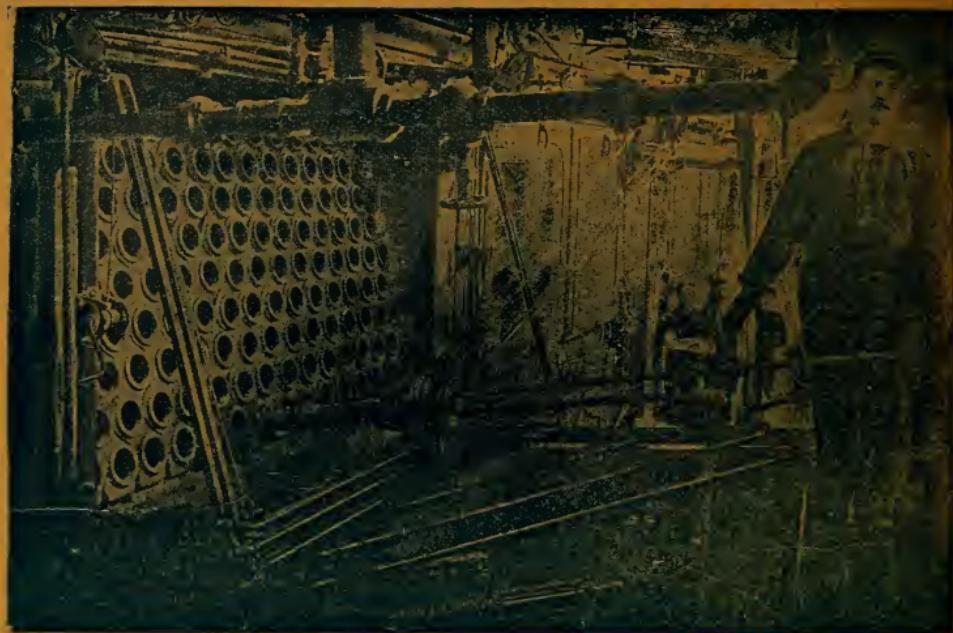
Consider for a moment the sheer folly of attempting to accomplish, by hand, work that always taxes a five to ten horse power engine, or of attempting to do work requiring from two to six men for a long time, that can be accomplished very quickly and effectively with a simple piece of machinery.

It is the appreciation of the value of our devices that has made their introduction so rapid.

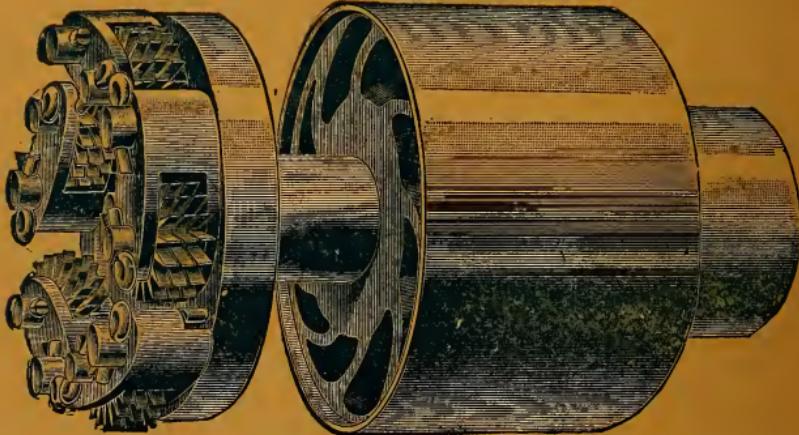
Agents wanted, on commission only, in every city and town in the United States. Commission will be paid to traveling men, preferably those having a line of Boiler Room Specialties.

UNION BOILER TUBE CLEANER CO.,

No. 254 Penn Avenue, - - - Pittsburgh, Pa., U. S. A.

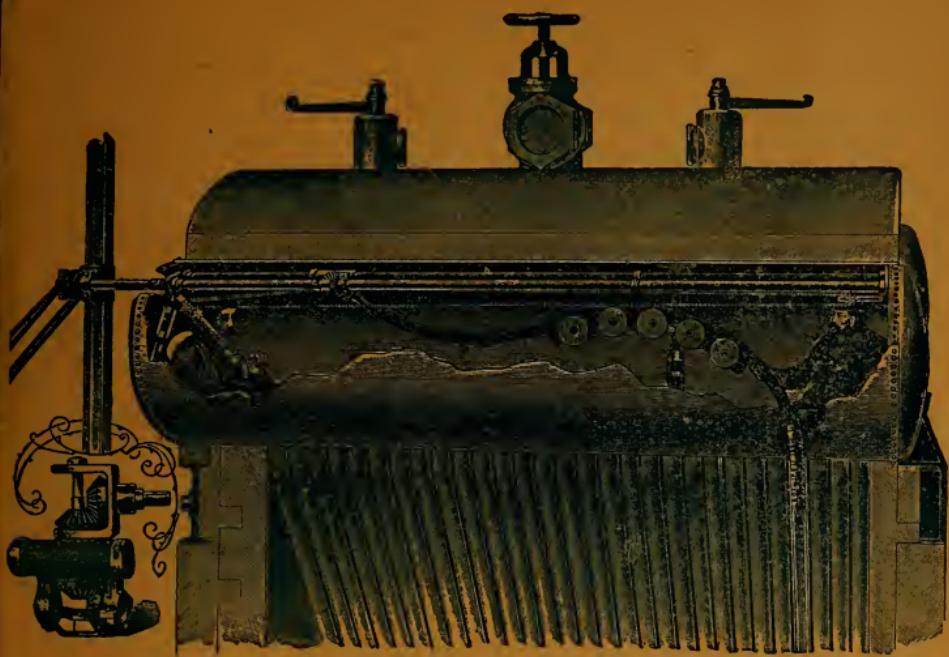


The above cut represents our No. 1 Device in position for cleaning the horizontal straight tubes of water tube boilers. This device not only removes all the scale without regard to quality or thickness, but also removes all the mill scale, which retards combustion, is a nucleus for the incrustation to attach itself to, and is in itself a source of loss of fuel; the device at the same time burnishing the interior of the tubes—which increases the radiation—being the acme of perfection in boiler cleaning, and which can be accomplished with no other device. We sell or lease this device, or clean boilers with it under contract.

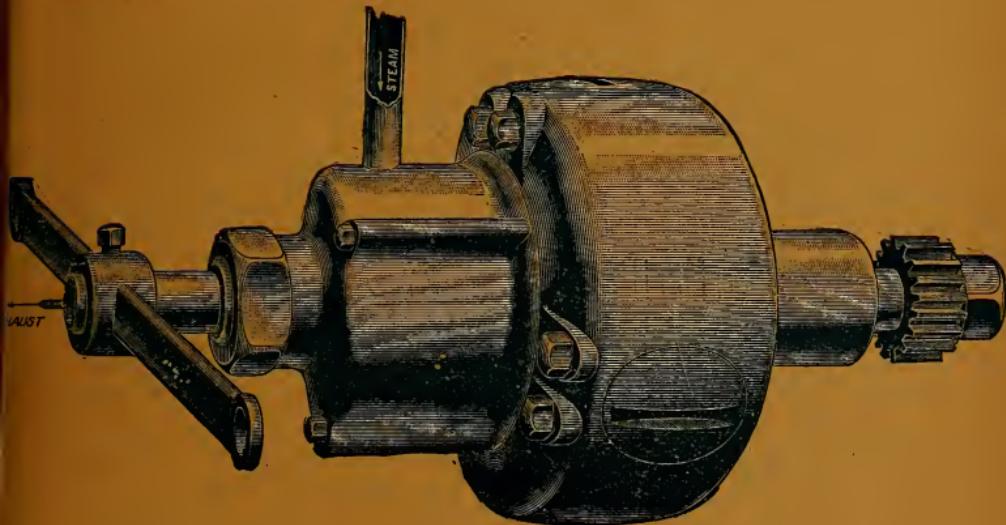


The above cut represents our IMPULSE CLEANER; is intended for keeping new boilers absolutely clean, and for use in both straight and curved water tube boilers; is guaranteed to remove all scale up to $\frac{1}{16}$ of an inch thick, and where the scale is soft will be equally effective up to $\frac{1}{8}$ of an inch scale; to be operated at not less than 100 pounds water pressure at the Cleaner. Where this Cleaner will not meet existing conditions it follows that cleaning by our No. 1 or No. 2 Device is necessary; after which our Impulse Cleaner will keep them in an absolutely clean condition at a trifling cost.

UNION BOILER TUBE CLEANER CO.
254 Penn Ave., - - - - - Pittsburgh, Pa., U. S.



The above cut represents our No. 2 Device in position for cleaning the Stirling type of boilers. In this case the feeding gear is set vertically inside the drum for Cook and Central Heating Boilers, and is set horizontally for Mt. Hope boilers. This device is used for any other form of boiler tube having curved tubes, and is the only device by which any form of boiler can be PROPERLY CLEANED AT ALL, and by which they can be as thoroughly and as cheaply cleaned as can the straight tube boilers. We sell or lease this device, and will supply it to contractors with it under contract.



The above cut represents our **VOLUMETRIC STEAM OR COMPRESSED AIR MOTOR**, being a compact high speed motor, having the least possible weight, with few parts; very durable, and economical in the use of motive fluid. It has no dead centre; is made with or without reversing gear, is completely incased, no exposure of the working parts; is peculiarly adapted for all cases where electricity or steam are objectionable, and where the use of stored compressed air is desired; for portable power, flexible shafts, street cars, motor vehicles, yachts, direct connected electric collectors, fan blowers, ventilating fans, centrifugal pumps, torpedo motors, and for driving machinery of all kinds. The first cost and maintenance are about one-half that of any first-class, similar size engine in the market. Weight of a one-half horse power motor, complete with the reversing gear—all being shown in the cut—is twenty-six (26) pounds; dimensions over all, seven by fourteen inches; size, one-half horse power upward.

UNION BOILER TUBE CLEANER CO.,
254 Penn Ave., - - Pittsburg, Pa., U. S. A.



The accompanying cut represents our FORSYTH FLEXIBLE SHAFT, the core of which is composed of phosphor bronze links; is made in sections of any desired length up to eight feet; the parts and fittings being interchangeable, can be put together to make any length desired by the user. The novelty, strength and durability of this flexible shaft, which can be made any size and length and suitable for all purposes, with the fact that unskilled labor can quickly replace a broken part, repairs not being necessary, commends itself to users on sight.

On your informing us of the number of shaft you have been using, or the size you think would answer any contemplated purpose, or on your stating the number of revolutions and the nature of the work you would like to accomplish, we will suggest size and attachments and quote you prices on special features.

We will enable you to accomplish what has heretofore been deemed impossible with a flexible shaft; it, in connection with our Volumetric Motor, either steam or compressed air, owing to its compactness, light weight, and high speed, makes a long desired combination for all kinds of work heretofore accomplished, if at all, in a makeshift sort of a way.

We have just received testimonial from the user of the first Flexible Shaft sold, stating: "It has given perfect satisfaction in every manner; never had a minute's trouble with it, and think its staying qualities are phenomenal." This after thirteen months' constant use, in all of which time no repairs whatever have been necessary.

UNION BOILER TUBE CLEANER CO.,

254 PENN AVE.,

PITTSBURG, PA., U. S. A.

TUBE CLEANERS.

McCLAVE, BROOKS & CO., 466 Bourse Bldg. (See page 54.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)
STEWART HEATER CO., 51 Norfolk Ave., Buffalo, N. Y. (See page 49.)
UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

TURRET LATHES.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

TYUERE IRONS.

ROOTS, P. H. & F. M. CO., 109 Liberty St., New York. (See insert opp. page 82.)

VALVE OIL.

See also Oils, Lubricating.

2912 LEONARD & ELLIS, 433 N. Third St.
5836D WILSON-CLARK CO., 107 S. Water St.

VALVES.

Allison Mfg. Co., cor. Walnut and 32d Sts.

ASHTON VALVE CO., 271 Franklin St., Boston, Mass.

Bond, Chas., 520 Arch St.

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)

Brogan & Co., 810 Race St.

Chapman Valve Mfg. Co., cor. Seventh and Filbert Sts.

1760 CRANE CO., 220-222 S. Fifth St. (See page 79.)

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

765 DANIEL, CHAS. A., 409 Market St. (See insert opp. page 10.)

1514 DILKS, FRANK W., & CO. "LUDLOW," 518 Arch St.

EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)

6963 EVIN, Thos., 1114 Frankford Ave.

3176 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

Ford & Kendig Co., 27 N. Seventh St.

Getze & Bro., 507 Arch St.

4585 GRIFFING, A. A., IRON CO. "BUNDY," 702 Arch St.

Hunter & Dickson, 245 Arch St.

HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

826 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)

Kaltenthaler, H. J., 236 Cherry St.

Keating Rubber Co., 509 North St.

Latta & Mulconroy, 1217 Market St.

LOCKE REGULATOR CO., Salem, Mass. (See page 39.)

Lonergan, J. E., & Co., 211 Race St.

1514 LUDLOW VALVE CO. (Frank W. Dilks & Co., Agts.), 518 Arch St.

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

McCambridge & Co., Ltd., 523 Cherry St.

Maneely, John, 209 Arch St.

Onderdonk Co., 119 S. Fourth St.

Pancoast, H. B. & Co., 213 S. Third St.

4549 PENNA. MACHINE CO., 31 N. Seventh St.

PEERLESS RUBBER MFG. CO., THE, 16 Warren St., N. Y. (See inserts opp. pages 68-69.)

PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)

Perkes, Chas., 627 Arch St.

Schutte, L., & Co., cor. 12th and Thompson Sts.

216 SCIPLE PUMP & MACHINE CO. (H. E. Trotman, Mgr.), 107-109 N. Third St.

Shaw, Thos. M. E., 915 Ridge Ave.

Smith, James, & Co., Inc., 411 Race St.

Spaulding & Metcalf, 532 Arch St.

5702 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

Williamson & Cassedy, 526 Market St.

Wood, R. D., & Co., 400 Chestnut St.

VALVES (ANGLE, GLOBE AND RADIATOR).

ASHTON VALVE CO., 271 Franklin St., Boston, Mass.

CRANE CO., 220-222 S. Fifth St. (See page 79.)

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

1514 DILKS, FRANK W., & CO. "LUDLOW," 518 Arch St.

EASTWOOD WIRE MFG. CO., 120 Liberty St., N. Y. (See inside front cover.)

6963 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

4585 GRIFFING, A. A., IRON CO. "BUNDY," 702 Arch St.

826 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)

LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

VALVES (AUTOMATIC AND AIR).

ASHTON VALVE CO., 271 Franklin St., Boston, Mass.

1760 CRANE CO., 220-222 S. Fifth St. (See page 79.)

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

1514 DILKS, FRANK W., & CO. "LUDLOW," 518 Arch St.

EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

6963 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

3176 GRIFFING, A. A., IRON CO. "BUNDY," 702 Arch St.

4585 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)

826 LUNKENHEIMER CO., THE, 26 Cortlandt St., N. Y. (See inside back cover.)

* VALVES (AUTOMATIC FLOAT).

1514 DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.

VALVES (AUTOMATIC EXHAUST RELIEF).

1514 CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.

VALVES (BACK PRESSURE NOISELESS).

Brogan & Co., "Kieley's," 810 Race St.
1514 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)
4549 PENNA. MACHINE CO., 31 N. Seventh St.

VALVES (BLOW OFF).

1716 CRANE CO., 220-222 S. Fifth St. (See page 79.)
1514 DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
5702 WATSON & McDANIEL CO., 144 N. Seventh St. (See page 2.)

VALVES (GATE).

1760 Chapman Valve Mfg. Co., cor. Seventh and Filbert Sts.
CRANE CO., 220-222 S. Fifth St. (See page 79.)
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
1514 DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.
6963 EVNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
1514 LUDLOW VALVE MFG. CO. (Frank W. Dilks & Co., Agts.), 518 Arch St.
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

VALVES (POP SAFETY).

1760 ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.
CRANE CO., 220-222 S. Fifth St. (See page 79.)
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
EASTWOOD WIRE MFG. CO., 120 Liberty St., New York. (See inside front cover.)
6963 EVNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
826 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

VALVES (REDUCING PRESSURE).

1760 ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.
CRANE CO., 220-222 S. Fifth St. (See page 79.)
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
EASTWOOD WIRE MFG. CO., 120 Liberty St., New York. (See inside front cover.)
3176 FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
826 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)
ROBERTSON MFG. CO., Betz Bldg. (See page 79.)
SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

VALVES (RUBBER).

4747 BOYD, JAMES, & BRO., 14 N. Fourth St. (See insert opp. page 57.)
1514 CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.
PEERLESS RUBBER MFG. CO., THE, 16 Warren St., New York. (See inserts opp. pages 68-69.)

VALVES (WATER RELIEF).

1514 ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
DILKS, FRANK W., & CO., "LUDLOW," 518 Arch St.
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
826 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

VENTILATING APPARATUS.

5264 B. F. STURTEVANT CO., 135 N. Third St. (See page 33.)
Baker, Smith & Co., 520 Commerce St.
Climax Machine Co., Inc., 68 N. Fourth St.
6963 EVNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)
Francis Bros. & Jellett, Inc., 704 Arch St.
Grant, Adolph & Co.
Merchant & Co., Inc., 517 Arch St.
Smead & Wills Warming and Ventilating Co., The, 417 Locust St.
Thompson Bros., 112 Bread St.
Wood, James P., Heating Co., The, 39 S. Fourth St.

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Francis Bros. & Jellett, Inc., 704 Arch St.
1527 Merchant & Co., Inc., 517 Arch St.
SMITH, H. B., CO., THE, 510 Arch St. (See page 77.)
Schnitzler, Chas. H., 215 N. Second St.
Wood, Jas. P., Heating Co., The, 39 S. Fourth St.

* VERTICAL SHAFTING.

6805 CRESSON, GEO. V., CO., 18th St. cor. Allegheny Ave.

* VISES (COMBINATION).

ARMSTRONG MFG. CO., THE, Bridgeport, Conn. (See insert opp. page 33.)

VISES (MACHINISTS' AND PIPE).

ARMSTRONG MFG. CO., THE, Bridgeport, Conn. (See insert opp. page 33.)
Energetic Mfg. Co., 233 Cherry St.
Gumphert, Geo. A., & Co., 238 Cherry St.

* VOLUMETRIC ENGINES AND MOTORS.

UNION BOILER TUBE CLEANER CO., Pittsburgh, Pa. (See inserts opp. pages 82-83.)

* WATER COLUMNS (SAFETY).

HUYETTE, P. B. "RELIANCE," 1213 Betz Bldg. (See page 2.)

WATER GAUGES.

See also Water Columns.

3176 ASHTON VALVE CO., THE, 271 Franklin St., Boston, Mass.
CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)
PENBERTHY INJECTOR CO., Detroit, Mich. (See page 58 and back cover.)

WATER HEATERS, NOISELESS.

6963 EYNON-EVANS MFG. CO., THE, cor. 15th and Clearfield Sts. (See page 58.)

* WATER PROOFING FOR LEATHER.

CLING-SURFACE MFG. CO., 169-174 Virginia St., Buffalo, N. Y. (See insert opp. page 32.)

WATER RELIEF VALVES.

See also Valves.

1514 ASHTON VALVE CO. THE, 271 Franklin St., Boston, Mass.
6963 CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.
3176 DILKS, FRANK W., & CO., "LUDLOW" 518 Arch St.
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FAIRBANKS CO., THE, 701 Arch St. (See front cover.)
HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)
826 JENKINS BROS., 117 N. Fourth St. (See inside front cover.)

WATER-TUBE BOILERS.

ALMY WATER TUBE BOILER CO., 178-184 Allens Ave., Providence, R. I.
(See page 86.)

Babcock & Wilcox Co., 642 Drexel Bldg.
Clonbrock Steam Boiler Works, Bourse Bldg.
Cramp, Wm., & Sons, Ship & Engine Building Co., Beach and Palmer Sts.
Erie City Iron Works, 1420 Chestnut St.

Gill, John L., Jr., 608 Drexel Bldg.
6870 HARRISON SAFETY BOILER WORKS, 17th St. bel. Allegheny Ave. (See pages 50-75.)

4864D HEINE SAFETY BOILER CO., 658 Bourse Bldg. (See page 87.)
McNeil Boiler Works, 1001 Chestnut St.

National Water Tube Boiler Co., Stephen Girard Bldg.

1781 PHILADELPHIA ENGINEERING WORKS, Ltd., cor. Mifflin and Meadow Sts.

PHOENIX IRON WORKS CO., Meadville, Pa. (See page 45.)

STIRLING CO., THE, 205 Betz Bldg. (See page 87.)

Thayer & Co., Inc., 542 Drexel Bldg.

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CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

EASTWOOD WIRE MFG. CO., 120 Liberty St., New York. (See inside front cover.)

HUYETTE, P. B., 1213 Betz Bldg. (See page 2.)

Lonergan, J. E., & Co., 211 Race St.

LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

SHERWOOD MFG. CO., Buffalo, N. Y. (See page 52.)

* WHISTLES (CHIME).

CROSBY STEAM GAGE & VALVE CO., 93 Oliver St., Boston, Mass.

LUNKENHEIMER CO., THE, 26 Cortlandt St., New York. (See inside back cover.)

WIRE ROPE AND CABLES.

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Washburn & Moen Mfg. Co., 707 Filbert St.

Williamson & Cassedy, 526 Market St.

WOOD-SPLIT PULLEYS.

Bond, Chas., 520 Arch St.

FAIRBANKS CO., THE, 701 Arch St. (See front cover.)

WOOD-WORKING MACHINERY.

1718 CREGAR, J. W., Machinery Dept., Bourse Bldg. (See insert opp. page 11.)

WRENCHES (PIPE).

ARMSTRONG MFG. CO., Bridgeport, Conn. (See insert opp. page 33.)

Billany & Cochrane, 527 Commerce St.

YACHT BOILERS AND ENGINES.

ALMY WATER TUBE BOILER CO., 178-184 Allens Ave., Providence, R. I.

(See page 86.)

Cramp, Wm., & Sons, Ship & Engine Building Co., Beach and Palmer Sts.

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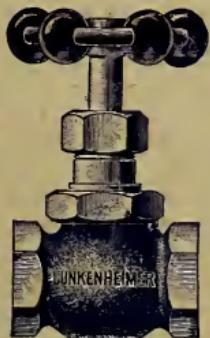
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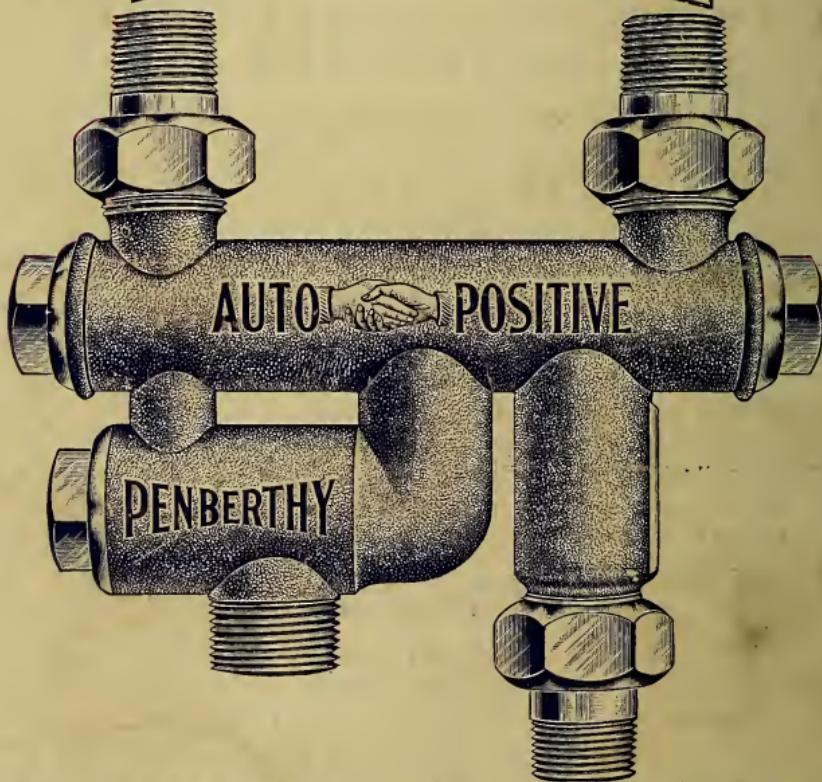
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